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5254A FREQUENCY CONVERTER

SN- 514-02355

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OPERATING AND SERVICE MANUAL

HEWLETT hp PACKARD

HP 5254A

HEWLETT hp PACKARD

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period. No other warranty is expressed or implied. We are not liable for consequential damages.

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MANUAL CHANGES

MODEL 5254A

FREQUENCY CONVERTER

Manual Serial Prefixed: 514-
Manual Printed: SEPT 1965

MAKE ALL CORRECTIONS IN THIS MANUAL ACCORDING TO ERRATA BELOW, THEN CHECK THE FOLLOWING TABLE FOR YOUR INSTRUMENT SERIAL PREFIX (3 DIGITS) OR SERIAL NUMBER (8 DIGITS) AND MAKE ANY LISTED CHANGE(S) IN THE MANUAL.

► NEW ITEM.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES	SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

ERRATA

Table 6-1, 6-2,
Change: A5R3 Part No. from 2100-0902 to 2100-0723.
Add: MP15 Meter Bezel, hp Part No. 5040-0185.

► Figure 5-9, Table 6-1,
Change: A5R32 from 2400 ohms to 3900 ohms, hp Part No. 0683-3925.
Add: A5E1 ferrite bead, hp Part No. 9170-0024.29
Add bead on emitter of A5Q12.

Dec. 14, 1966

Supplement A for
05254-9008

PRINTED IN U.S.A.

OPERATING AND SERVICE MANUAL

MODEL 5254A
FREQUENCY CONVERTER

SERIALS PREFIXED: 514-

This manual applies directly to Model 5254A Frequency Converters having serial prefix number 514.

OLDER INSTRUMENTS

This manual with changes provided in Appendix I also applies to converters having serial prefix numbers 429 and 415.

02010-3 Printed: SEPT 1965

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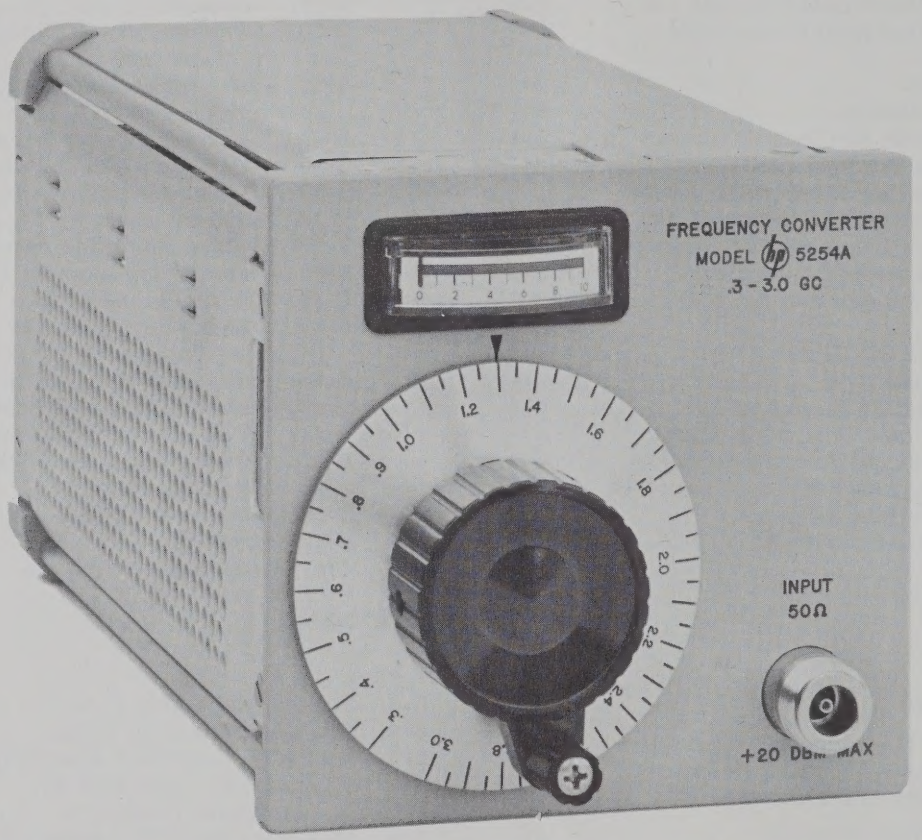


Figure 1-1. Model 5254A

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Hewlett-Packard Model 5254A Frequency Converter is a plug-in unit which extends the frequency measuring capability of an hp Model 5245L Electronic Counter from .3 to 3.0 Gc (300 Mc to 3000 Mc).

1-3. The stability and accuracy of the basic counter are retained by multiplying a 10-Mc signal, derived from the 1-Mc internal time base of the counter, to 50 Mc and selecting a harmonic frequency between 300 and 2950 Mc. This known harmonic of 50 Mc is then heterodyned with the INPUT signal. The resulting difference frequency, if between 1 Mc and 53 Mc (bandwidth of amplifier in plug-in) is counted and displayed by the counter. The frequency of the INPUT signal is then indicated by the combination of the MIXING FREQUENCY control (in gigacycles; front panel of plug-in) and the digital display of the counter (in megacycles).

1-4. A front panel meter, by monitoring the difference-frequency output of the plug-in to the counter, aids in selecting the desired MIXING FREQUENCY and also in determining if INPUT signal amplitude is adequate for accurate frequency measurement.

1-5. SPECIFICATIONS.

1-6. Table 1-1 contains all technical specifications for the Model 5254A when operated in the Model 5245L Electronic Counter.

1-7. INSTRUMENT IDENTIFICATION.

1-8. Hewlett-Packard identifies each Model 5254A with a two-section, eight-digit serial number. If the first three digits of the serial number of your instrument do not agree with those on the title page of this manual, change sheets supplied with the manual will define the differences between your instrument and the Model 5254A described in this manual.

1-9. COOLING.

1-10. The Model 5254A is cooled by the ventilation system of the counter in which it is installed. See operating and service manual of counter for cooling system maintenance instructions.

Table 1-1. Specifications*

RANGE:
As a converter for the hp 5245L Electronic Counter, 300 to 3000 Mc.

ACCURACY:
Retains accuracy of the hp 5245L

INPUT SIGNAL LEVEL:
50 mv rms (-13 dbm in 50 ohms) to 1 v rms (+13 dbm in 50 ohms)

INPUT OVERLOAD:
Input power in excess of 100 mw (+20 dbm or 2.2 v rms) may damage the converter

INPUT IMPEDANCE:
Approximately 50 ohms

INPUT CONNECTOR:
Type N female

LEVEL INDICATOR:
Meter aids frequency selection; indicates output voltage level to counter.

REGISTRATION:
Counter display in Mc is added to the converter dial reading.

WEIGHT:
Net, 5 lbs (2, 5 kg)
Shipping 9 lbs (4 kg)

*When used with hp 5245L Electronic Counter.

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information on unpacking, inspection, repacking, storage, and installation.

2-3. UNPACKING AND INSPECTION.

2-4. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (scaratches, dents, broken knobs, etc). If the instrument is damaged or fails to meet specification (Performance Check, Table 5-4), notify the carrier and the nearest Hewlett-Packard field office immediately (field offices are listed at the back of this manual). Retain the shipping carton and the padding material for the carrier's inspection. The field office will arrange for the repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. STORAGE AND RESHIPMENT.

2-6. PACKAGING. To protect your instrument during shipment or storage, use the best packaging methods available. Your Hewlett-Packard field office can provide materials similar to those used for original factory packaging. Contract packaging companies can provide dependable custom packaging on short notice.

a. If possible, use the original container designed for the instrument. Otherwise, use a strong carton (350 lb/sq inch bursting strength) or wooden box to house the instrument.

b. Wrap the instrument in heavy paper or plastic before placing it in the shipping container.

c. Use plenty of packing material around all sides of the instrument and protect the front panel with cardboard strips.

d. Seal the package with strong tape or metal bands. Mark with "Delicate Instrument."

e. Refer to the address list at the rear of this manual and check with your Hewlett-Packard field office for shipping instructions. All correspondence should refer to an instrument by Model number and the full eight-digit serial number.

2-7. ENVIRONMENT. Conditions during storage and shipment should normally be limited as follows:

a. Maximum temperature 167°F (75° C).

b. Minimum temperature -40°F (-40°C).

CAUTION

TURN COUNTER POWER OFF BEFORE INSTALLING OR REMOVING FREQUENCY CONVERTER.

2-8. INSTALLATION.

2-9. The Model 5254A plugs into the rectangular compartment at the right-hand side of the front panel of the Model 5245L Electronic Counter. To install unit in counter, first check that retaining latch (see Figure 3-1) is turned fully counterclockwise, then push unit firmly into compartment until front panel of plug-in is flush with front panel of counter. Then turn retaining latch clockwise untilit is tight.

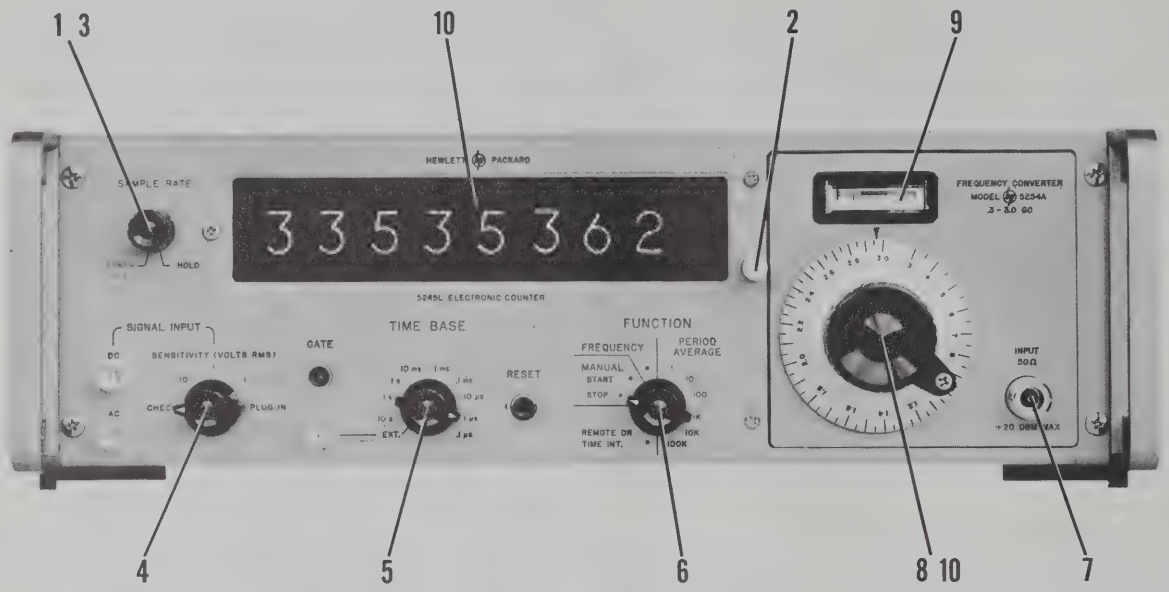
2-10. To remove unit from counter, turn retaining latch counterclockwise to its stop. Then grasp mixing frequency selector (see Figure 3-1) and firmly pull unit from counter. If any difficulty is encountered with installation or removal, check that retaining latch is fully counterclockwise.

2-11. POWER REQUIREMENTS.

2-12. All electrical power required to operate the Model 5254A is supplied by the counter in which the unit is installed.

2-13. ELECTRICAL CONNECTIONS.

2-14. INPUT connector on front panel of plug-in (see Figure 3-1) is the only external electrical connection to the unit. All other connections are made through the 50-pin connector at the rear of plug-in when installed in counter.



1. Turn SAMPLE RATE control to POWER OFF.
2. Plug in Model 5254A, turning knurled knobs clockwise until tight.
3. Turn SAMPLE RATE control slightly out of POWER OFF position.
4. Set SENSITIVITY to PLUG IN.
5. Set TIME BASE to 10 ms*.
6. Set FUNCTION to FREQUENCY.

*TIME BASE setting may vary, depending on desired resolution of INPUT signal frequency, see Table 3-1.

7. Connect signal whose frequency is to be measured to INPUT of converter.
8. Set Mixing Frequency Control to read slightly less than .3 Gc.
9. Slowly turn Mixing Frequency Control counterclockwise to obtain the first response, and tune for a maximum reading in the green portion of the Level Indicator Meter scale.
10. Add counter display (in kc) to Mixing Frequency Control reading (in Gc) for frequency of INPUT signal.

05254-A-2

Figure 3-1. Frequency Measurement Procedure

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. The Model 5254A Frequency Converter increases the range of the 5245L Electronic Counter to .3 thru 3.0 Gc (300 through 3000 Mc). As a general rule to measure frequency, always start with the Mixing Frequency Control below .3 Gc and tune upward in frequency to obtain first response and tune for a maximum reading in the green portion of the meter scale. The input frequency is the sum of the counter reading and the dial frequency reading. This procedure will be valid whether there are responses in 1, 2, or 3 consecutive harmonic reference frequencies; see Figure 3-2. If the input signal level to the converter is high, the second, third and other harmonics of this signal may be generated. Therefore, tuning Mixing Frequency Control from the low end upward will enable the input fundamental frequency to be detected before its harmonics. In the 5254A harmonics of the reference-frequency signals are held to such a low level that regardless of input signal level, their mixing effects are not observable, avoiding possible ambiguity. Figure 3-1 provides a step-by-step procedure to be used for measurement of frequencies from .3 to 3.0 Gc (300 Mc to 3000 Mc). The only exception is if the first response occurs at .3 Gc or .35 Gc. To avoid possible ambiguity in these cases, start from above .45 Gc and tune downward in frequency for the first response and subtract the counter reading from the dial frequency for the frequency of the input signal.

Note

If the input frequency is known approximately, the Mixing Frequency Control can be set a hundred megacycles below the input signal. Tune up for the first response and add the counter reading to the dial frequency.

3-3. CONTROLS AND INPUT.

3-4. GENERAL. The function of the front panel control, meter, connector, and retaining screws are shown in Figure 3-1.

3-5. INPUT CONNECTOR. Signal input, 50 ohms input impedance, 50 mv (-13 dbm in 50 ohms) to 1 v rms (+13 dbm in 50 ohms) into Type N female connector.

3-6. MIXING FREQUENCY SELECTOR. Calibrated from .3 to 3.0 Gc (300 Mc to 3000 Mc), this control tunes the internal cavity to select a harmonic of 50 Mc to be heterodyned with the INPUT signal.

3-7. LEVEL INDICATOR METER. The meter circuit continuously monitors the level of the difference frequency output of the converter to the counter. When meter reads in the green portion of its scale, INPUT signal amplitude is adequate for accurate frequency measurement.

3-8. RETAINING LATCH. The latch which holds the converter in place is located on the front panel of the counter. To tighten, turn fully clockwise. To loosen, turn fully counterclockwise.

3-9. MAXIMUM INPUT VOLTAGES.

3-10. Damage to the converter may result if an AC signal greater than +20 dbm in 50 ohms (2.2 v rms) or a DC voltage greater than 100 v is applied to converter INPUT connector.

3-11. FREQUENCY MEASUREMENT WITH AMPLITUDE LESS THAN 50 MV RMS.

3-12. The front panel level indicator meter indicates in the green portion of its scale only when converter

Table 3-1. Frequency Resolution

INPUT SIGNAL FREQUENCY = 2.4911223344 Gc MIXING FREQUENCY CONTROL set to 2.45 Gc		
Time Base Setting	Counter Display	Measurement Resolution
.1 μs	*(no display)	
1 μs	41.Mc	2.491 Gc
10 μs	4.11 Mc	2.4911 Gc
.1 ms	41.12 Mc	2.49112 Gc
1 ms	411 22 kc	2.491122 Gc
10 ms	411 22.3 kc	2.4911223 Gc
.1 s	411 22.33 kc	2.49112233 Gc
1 s	4112 2.3 34 kc	2.491122334 Gc
10 s	11 22.3 344 kc	2.4911223344 Gc

is properly tuned and amplitude of INPUT signal is adequate for accurate frequency measurement. However, because of conservative specifications of both the converter and counter, frequencies may often be accurately measured when meter reads in the red portion of its scale. To make these extended range measurements:

a. Follow normal procedure (Figure 3-1) except that mixing frequency control should be tuned for first maximum reading on the level indicator meter, regardless of the color of region.

b. Check frequency measurement result as described in Paragraph 3-13.

3-13. DOUBLE CHECKING FREQUENCY MEASUREMENT RESULT.

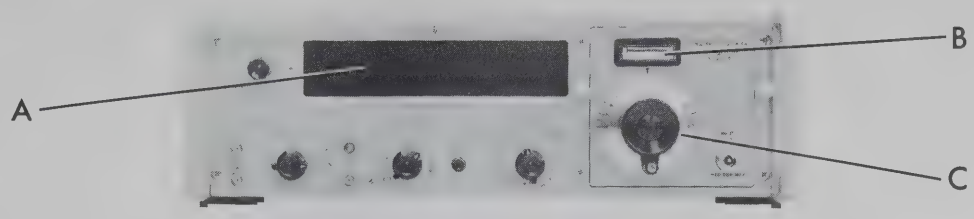
3-14. Because of the heterodyne action of the converter, frequency measurement results obtained at any one setting of the Mixing Frequency Control may be checked at other settings. In most cases these will be two consecutive responses: tune in the first response and add the counter display to dial frequency reading; then tune up in frequency to the second response and subtract the counter display from the dial frequency reading (see Table 3-2). In some cases there will be three consecutive responses (see Figure 3-2); in these cases the third response will be the one in which you subtract the counter display from the dial frequency reading.

3-15. AID TO RAPID TUNING.

3-16. To easily obtain an indication of the proper MIXING FREQUENCY when rapidly tuning the Model 5254A through its frequency range in search of an unknown INPUT frequency, set 5245L FUNCTION control to MANUAL START. This allows the counter to totalize each cycle of any difference frequency produced during rapid tuning. When 5245L display changes, indicating that the MIXING FREQUENCY is heterodyning with the INPUT frequency and producing a difference frequency within the frequency range of the basic counter, set counter FUNCTION control to FREQUENCY and proceed with measurement.

Table 3-2. Typical Double-Check Frequency Measurement

Input Frequency	Counter* Reading	Mixing Frequency	Meter Indication	
1.2345678 Gc	34567.8 kc	1.2 Gc	Peak	First Response: 1.2000000 Gc + 345678 kc 1.2345678 Gc
	15432.2 kc	1.25 Gc	Peak	Second Response: 1.2500000 Gc -154322 kc 1.2345678 Gc
*Note Counter in 10 ms Gate to give reading in kc				



INPUT FREQ	A*	B	C	
EXAMPLE OF ONE RESPONSE				
3020 MC	000000.00 MC	↓	2.95 GC (2950 MC)	NO RESPONSE, DIFFERENCE FREQUENCY GREATER THAN 1 MC TO 53 MC PASS BAND OF VIDEO AMPLIFIER.
	000020.00 MC	↓	3.0 GC (3000 MC)	FIRST RESPONSE 3000 MC + 20 MC = 3020 MC
EXAMPLES OF TWO RESPONSES				
1020 MC	000020.00 MC	↓	1.0 GC (1000 MC)	FIRST RESPONSE 1000 MC + 20 MC = 1020 MC
	000030.00 MC	↓	1.05 GC (1050 MC)	SECOND RESPONSE 1050 MC − 30 MC = 1020 MC
900 MC	000050.00 MC	↓	.85 GC (850 MC)	FIRST RESPONSE 850 MC + 50 MC = 900 MC
	000000.00 MC	↓	.90 GC (900 MC)	NO RESPONSE, DIFFERENCE FREQUENCY LESS THAN 1 MC TO 53 MC PASS BAND OF VIDEO AMPLIFIER.
	000050.00 MC	↓	.95 GC (950 MC)	SECOND RESPONSE 950 MC −50 MC = 900 MC
EXAMPLE OF THREE RESPONSES				
851 M	000051.00 MC	↓	.8 GC (800 MC)	FIRST RESPONSE 800 MC +51 MC = 851 MC
	000001.00 MC	↓	.85 GC (850 MC)	SECOND RESPONSE 850 MC + 1 MC = 851 MC
	000049.00 MC	↓	.9 GC (900 MC)	THIRD RESPONSE 900 MC −49 MC = 851 MC

* NOTE: COUNTER IN .1 MS GATE TO GIVE READING IN MEGACYCLES IN ALL EXAMPLES.

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Figure 3-2. Examples of 1, 2, and 3 Response Frequency Measurements

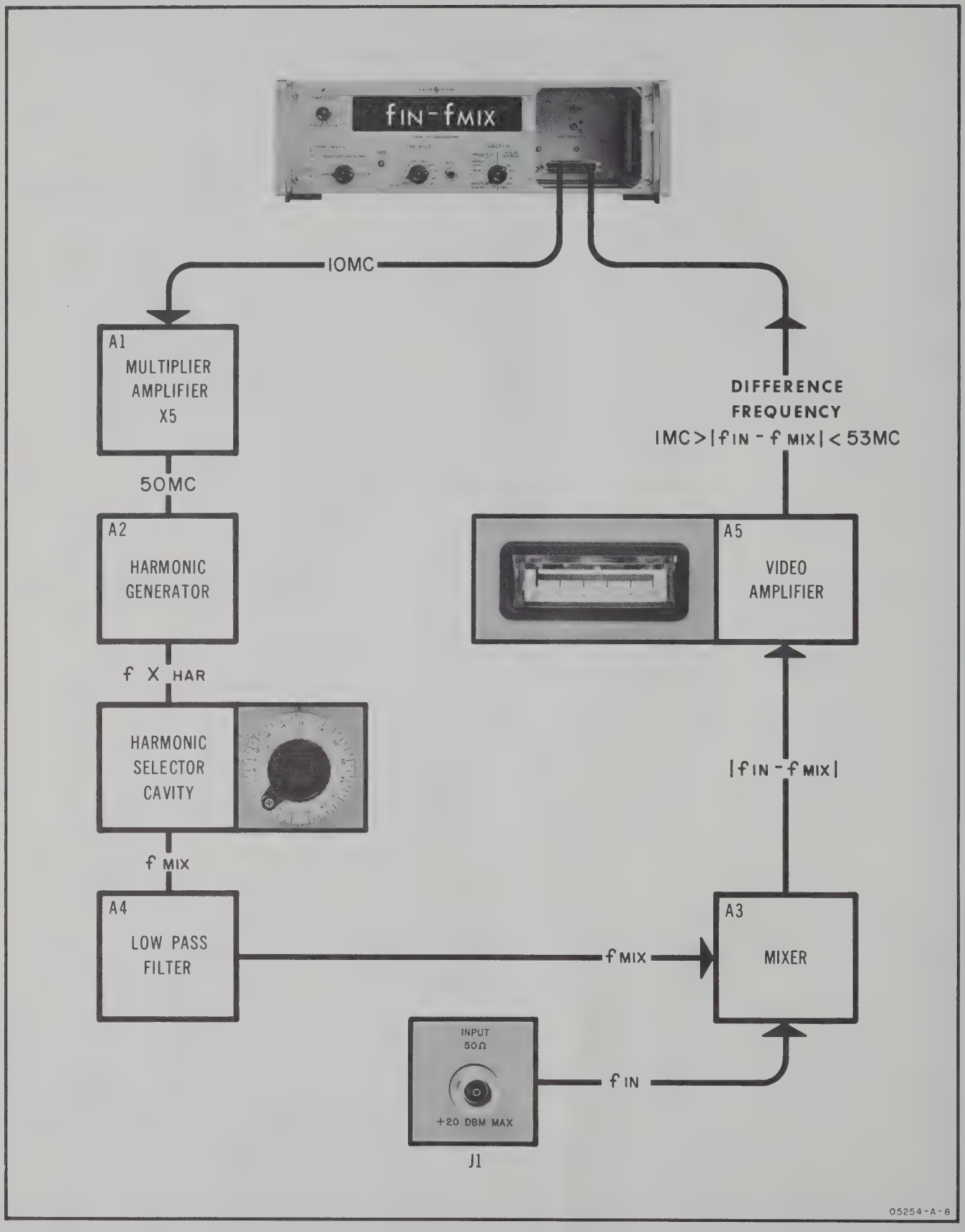


Figure 4-1. Over-all Block Diagram

SECTION IV
PRINCIPLES OF OPERATION

4-1. GENERAL.

4-2. The Model 5254A is a heterodyne frequency converter designed to extend the range of frequency measurement of the Model 5245L Electronic Counter to .3 Gc through 3 Gc (300 Mc through 3000 Mc).

4-3. The Converter contains five basic functional sections: multiplier amplifier, harmonic generator and harmonic selector cavity, mixer, filter, and video amplifier. (See Figure 4-1, and for circuit details refer to the schematic diagrams, Figures 5-6 and 5-9.)

4-4. In normal operation the harmonic generator produces all of the harmonics of 50 Mc between 300 Mc and 3000 Mc. The harmonic selector cavity is tuned to select one of these harmonics to be supplied through the low-pass filter to the mixer. The mixer output is the difference frequency produced by mixing of the input frequency and the frequency supplied by the harmonic selector cavity. This difference frequency is amplified by the video amplifier and supplied to the counter input circuit. A low-pass filter within the video amplifier prevents difference frequency signals above 53 Mc from reaching the counter input circuit. The output of the video amplifier is monitored by a meter circuit which indicates when difference frequency output amplitude is greater than the minimum signal required by the counter input circuit.

Note

In the following discussion complete reference designations are used to identify components. This is to prevent confusion between reference designations of components located on the chassis and components located on an assembly. For example, "R1" would refer to a component located on the chassis, while "A1R1" would refer to a component located on the multiplier amplifier assembly A1 (see Table 5-2 for assembly designations).

4-5. MULTIPLIER AMPLIFIER A1.
(see Figure 4-2).

4-6. A 10-megacycle signal from the counter is applied to buffer amplifier A1Q1. The buffer amplifier A1Q1 is a tuned amplifier providing a constant amplitude 10 Mc signal to the multiplier A1Q2, and provides isolation of converter from counter. The x5 multiplier A1Q2 is a tuned class C amplifier with the input tuned to 10 Mc and the resonant output tuned to the fifth multiple of the input signal providing a 50 Mc output signal. The output of the multiplier is amplified by A1Q3 and applied to the crystal filter. The half lattice crystal filter (A1Y1 and A1C13) is a 50 megacycle band-pass filter. A1C13 is used to balance out crystal capacitance. A series of tuned power amplifiers A1Q4, A1Q5, and A1Q6 amplify the signal from the crystal filter to drive the harmonic generator.

4-7. HARMONIC GENERATOR A2 AND HARMONIC SELECTOR CAVITY.
(See Figure 4-2)

4-8. The harmonic generator consists of a 50-Mc tuned circuit, driving the step recovery diode, A2CR1. The step recovery diode takes energy from the tuned circuit during a portion of each cycle of the 50 Mc oscillation and produces a sharp step in the current flowing through the diode. The diode forms a loop input coupling to the harmonic selector cavity and the step in the current through the diode makes available, inside the cavity, the harmonics of 50 Mc from 300 Mc (sixth harmonic) to 3000 Mc (sixtieth harmonic). The probe tunes the cavity to select the desired harmonic and provides coupling from the harmonic selector cavity through the filter assembly A4 to one of the two inputs of the mixer assembly A3.

4-9. FILTER ASSEMBLY A4. (See Figure 4-3)

4-10. The output signal of the harmonic selector cavity is applied to a Tschebyscheff low-pass filter (A4), with a cut-off frequncy of 3 Gc, to limit the selected mixing frequency. The filter has 50 ohm termination at both the input and output. The output signal from the filter (A4) is applied to one of the inputs of the mixer assembly (A3).

4-11. MIXER ASSEMBLY A3. (See Figure 4-3)

4-12. The mixer assembly uses two diodes in a balanced mixer circuit in order to minimize the generation of even order harmonics of both the input signal and the selected mixing frequency. The combination of the the terminating resistor A3R1 and the shunting effect of the diodes gives an input impedance of 50 ohms and provides a low standing wave ratio (typically below 1.5 up to 3.0 Gc. Capacitor A3C1 provides DC isolation up to 100 volts. A5R1, A5R2, and A5R3 control the bias currents of the mixer diodes (A3CR1 and A3CR2) and are adjusted for maximum common mode rejection within the video band (1 Mc to 53 Mc). The non-linearity of the diodes (A3CR1 and A3CR2) gives rise to signals with frequencies which are the sum and difference of the two mixing frequencies (INPUT frequency and selected mixing frequency). The difference frequency signal in particular is coupled to the input of the differential amplifier (A5Q1 and A5Q2) through coupling resistors (A3R3 and A3R4) as a differential signal.

4-13. VIDEO AMPLIFIER A5. (See Figure 4-3)

4-14. The two signals from the mixer (A3) are applied to the bases of the differential amplifier A5Q1 and A5Q2. The output is taken from A5Q1 and A5Q2 and applied to the bases of the second stage of differential amplification (A5Q3 and A5Q4). Negative feedback from the emitters of differential amplifier A5Q3 and A5Q4 to differential amplifier A5Q1 and A5Q2

provides low distortion, stable amplification. The differential amplifiers amplify the difference between the two signals with one output (A5Q3 collector) going to ground, and the other A5Q4 collector, applied to the base of A5Q5. A5Q5 and A5Q6 form a feedback amplifier providing a constant gain of 10. A5Q7 and A5Q8 limit the signal and provide a high impedance at the collector of A5Q8. This high impedance is shunted with a 100-ohm resistor (A5R24) to provide the 100 ohms input impedance required by the low pass filter. The low pass filter, a three-section Tschebycheff filter, provides a 53-Mc cutoff frequency for the video amplifier. The filter output is applied to A5Q9. A5Q9 and A5Q10 form a shunt feedback amplifier providing a low impedance input at the base of A5Q9. This in series with a 91-ohm resistor (A5R25) provides the 100 ohms output impedance required by the low pass filter. The output signal at the emitter of A5Q10 is applied to the base of A5Q11. A5Q11 is a buffer amplifier with a resistive divider output providing the output to the counter and the external output. With the external output terminated with 50 ohms, output to the counter is twice as large as the external output. There is sufficient isolation in the divider network to prevent the signal to the counter from being affected by termination at the external output.

4-15. The signal for the meter amplifier is taken from the emitter of A5Q10 and applied to the base of A5Q12. The meter amplifier A5Q12 is a current amplifier driving the meter rectifier (A5CR2). A5R39 and A5C22 provide damping for the meter. A5C19 adjusts the meter amplifier high frequency gain to make level indicator meter read at red-green border when amplitude of converter output to counter is in excess of the 100 mv rms minimum signal amplitude normally required by the counter.

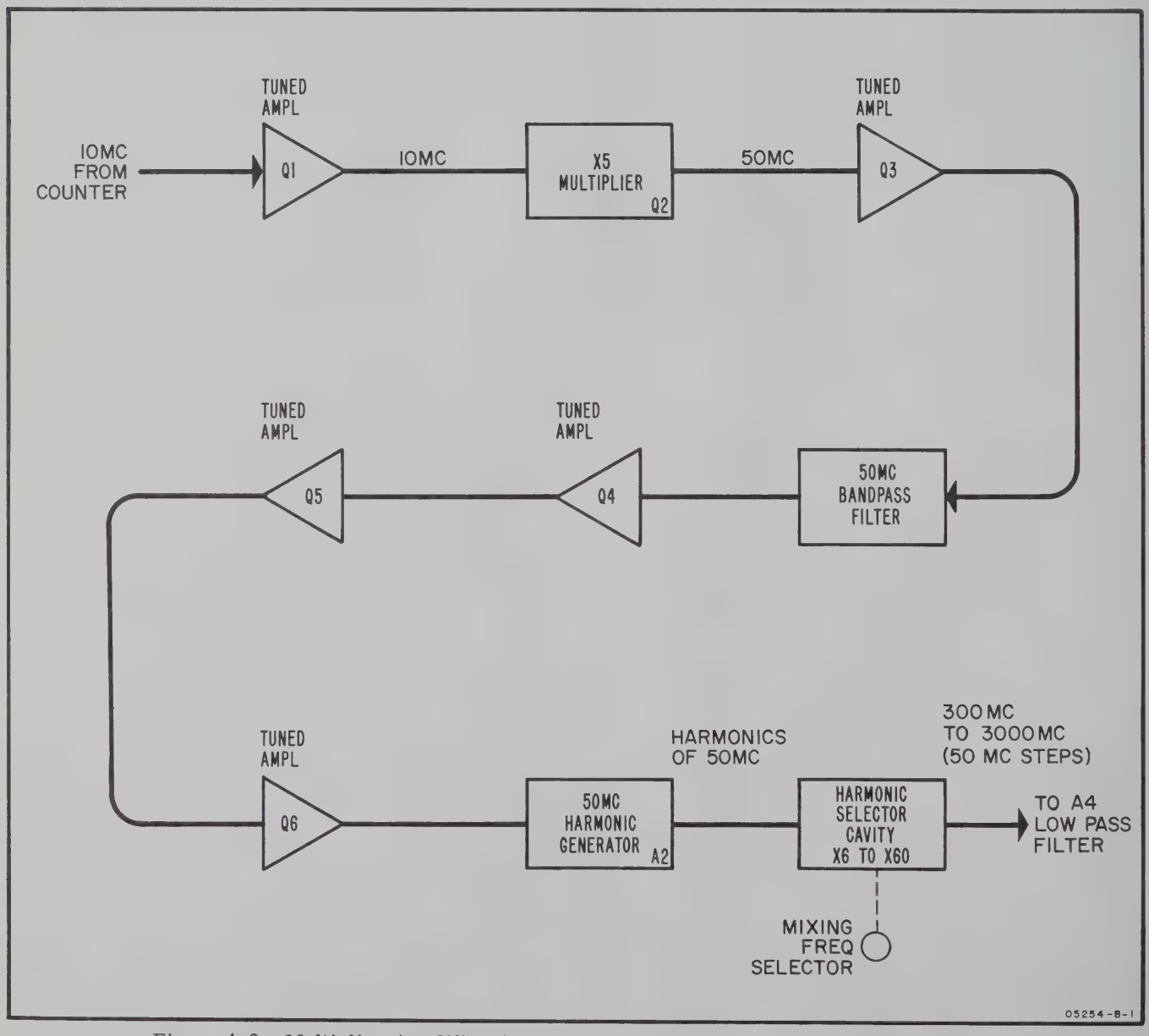


Figure 4-2. Multiplier Amplifier Assembly A1, Harmonic Generator Assembly A2, and Harmonic Selector Cavity, Block Diagram

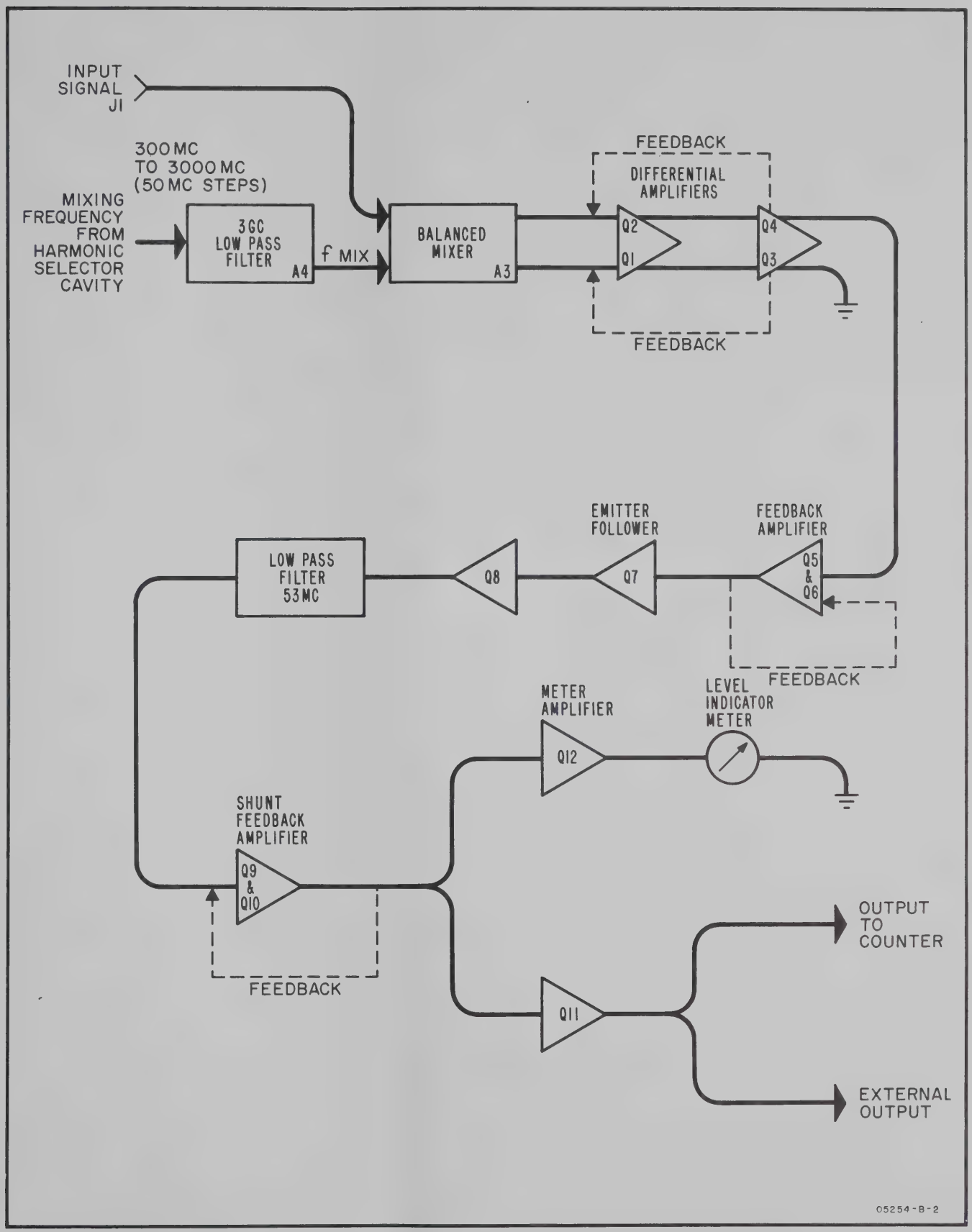


Figure 4-3. Low-Pass Filter Assembly A4, Mixer Assembly A3, and Video Amplifier Assembly, Block Diagram

Table 5-1. Recommended Test Equipment

Instrument	Required Characteristics	Use	Instrument Recommended
Electronic Counter		Supply Power, supplies 10 Mc signal Operational Indicator	℗ Model 5245L
VHF Signal Generator	300 Mc to 480 Mc 10 mv to .1 v	Performance Check Circuit Adjustment	℗ Model 608CD
UHF Signal Generator	450 Mc to 1230 Mc 10 mv to .1 v	Performance Check	℗ Model 612A
UHF Signal Generator	800 Mc to 2400 Mc 10 mv to .1 v	Performance Check	℗ Model 614A or 8614A
UHF Signal Generator	1.8 Gc to 4.5 Gc 10 mv to .1 v	Performance Check	℗ Model 616B or 8616A
DC VTVM and Ohmmeter	0 to + and -25 vdc .1 v resolution 0 to 100M ohms	Circuit Adjustment Troubleshooting	℗ Model 412A
RF Millivoltmeter	1 Mc to 20 Mc 10 mv to 10 vdc 10 mv resolution	Circuit Adjustment	℗ Model 411A ℗ 11025A Probe
Oscilloscope	1000 Mc bandwidth	Circuit Adjustment Troubleshooting	℗ Model 185B with 187B Plug-In
Termination	50 ohms feedthrough	Circuit Adjustment	℗ 10100A
R X Meter	60 Mc to 120 Mc	Circuit Adjustment	Boonton 250A
Spectrum Analyzer	3 Gc Frequency	Circuit Adjustment	℗ 851A and 8551A
Male BNC Plug Connector		Circuit Adjustment	℗ 1250-0052
BNC male to type N female adapter		Circuit Adjustment	℗ 1250-0077
Extension Cable	50 pin straight-thru	Circuit Adjustment	℗ 10506B
Oscillator Synchronizer		Performance Check	DY-2650A
Frequency Standard	1 Mc	Performance Check	℗ 107BR
Multiplier	X100, 1 Mc at 1v input	Performance Check	Modified ℗ 5275A

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides maintenance and service information for the Model 5254A Frequency Converter. Included are a periodic maintenance procedure, a table of recommended test equipment, an in-cabinet performance check which may be used to verify proper operation of the frequency converter, troubleshooting procedure, and repair and adjustment procedure.

5-3. PERIODIC MAINTENANCE.

5-4. No special maintenance procedures are required when the converter is operated in normal environments. However, if unit is subjected to operation in extremely dusty environments, periodically clean all gears with a lint-free cloth and apply a coating of light, petroleum base, open-gear grease to all gear teeth.

5-5. TEST EQUIPMENT.

5-6. Recommended test equipment for performance checking, troubleshooting and circuit adjustment after repair is listed in Table 5-1. Other test instruments may be used if their specifications equal or exceed the required characteristics.

5-7. IN-CABINET PERFORMANCE CHECK.

5-8. The following performance check (Table 5-4) verifies proper operation of all circuits in the Model 5254A Electronic Counter and may be used:

a. as part of an incoming inspection check of instrument specifications;

b. periodically, for instruments used in systems where maximum reliability is of utmost importance;

c. as part of a troubleshooting procedure to locate malfunctioning circuits, and

d. after any repairs or adjustments, before returning instrument to regular service.

5-9. TROUBLESHOOTING.

5-10. Refer to Section IV, Principles of Operation, for information on the operation of circuits. Table 5-2 gives the reference designations of assemblies used in the converter and their corresponding nomenclatures. Figures 5-2 and 5-3 show the location of all assemblies used in Model 5254A. Figures 5-5, 5-7, and 5-8 show component location on the assemblies. Table 5-4, Troubleshooting Aids, gives information on waveforms and DC voltages which are present when circuits are operating properly. The waveforms are referenced to test points throughout the converter. These test points are keyed to the schematic diagrams, Figures 5-6 and 5-9.

Table 5-2. Assembly Designations

A1 MULTIPLIER AMPLIFIER
A2 HARMONIC GENERATOR
A3 MIXER
A4 LOW PASS FILTER
A5 VIDEO AMPLIFIER

5-11. MULTIPLIER AMPLIFIER ASSEMBLY A1.

5-12. If the Multiplier Amplifier Assembly is suspected of being faulty, use the test points on the schematic diagram, Figure 5-6, and the test points and DC voltages given in Troubleshooting Aids, Table 5-4, in the following order 7, 1, 2, 3, 4, 5, and 6 to help isolate the faulty circuit.

5-13. MIXER ASSEMBLY A3.

5-14. A faulty mixer assembly is usually indicated by poor sensitivity, noisy signal output from the video amplifier. If the mixer assembly is suspected of being faulty, remove amplifier side plate (MP12), see Figure 5-3, and perform the resistance check given in Table 5-3.

Table 5-3. Mixer Resistance Check

Check	Connect Ohmmeter (hp 412A only)		Ohmmeter Scale	Reading
	Ohms Lead	Common Lead		
1	A3R3	Ground	X1K	Greater than 10K ohms
2	Ground	A3R3	X1K	600 - 1200 ohms
3	A3R4	Ground	X1K	600 - 1200 ohms
4	Ground	A3R4	X1K	Greater than 10K ohms

Note: These measurements can be made with the Mixer Assembly installed in the instrument and without unsoldering any wires.

a. If any reading for checks 1 thru 4 is 500 ohms, there is a short circuit in the mixer.

b. If checks 1 or 4 read less than 10K the diodes are defective.

c. If "infinity" is read there is an open circuit.

5-15. VIDEO AMPLIFIER ASSEMBLY A5.

5-16. A faulty video amplifier circuit can usually be detected by one simple check; short either input, base of A5Q1 or A5Q2 to ground and the amplifier should oscillate causing an increased level indicator meter reading. If it does not it may be presumed faulty. Use the test points in the schematic diagram, Figure 5-9, and the test points and DC voltages given in Troubleshooting Aids, Table 5-4.

5-17. REPAIR AND REPLACEMENT.

5-18. GENERAL.

5-19. Paragraphs 5-20 through 5-35 are replacement procedures to aid in repair of the converter. No attempt should be made to repair: 1) the Harmonic Generator A2; 2) the Harmonic Selector Cavity; 3) the Mixer Assembly A3, or 4) the Filter Assembly A4. These assemblies should be replaced as a unit. For assistance contact your Hewlett-Packard field office.

5-20. PRINTED CIRCUIT COMPONENT REPLACEMENT.

5-21. Component lead holes in the Model 5254A circuit boards have plated walls to ensure good electrical contact between conductors on the opposite sides of the board. To prevent damage to this plating and to the replacement component, apply heat sparingly and work carefully. The following replacement procedure is recommended:

a. Remove defective component.

b. Melt solder in component lead holes. Use clean dry soldering iron to remove excess solder. Clean holes with toothpick or wooden splinter. Do not use metal tool for cleaning as this may damage through-hole plating.

c. Bend lead of replacement component to the correct shape and insert component leads into component lead holes. Use heat and solder sparingly, solder leads in place. Heat may be applied to either side of board. A heat sink (longnose pliers, commercial heat-sink tweezers, etc) should be used when replacing transistors and diodes in order to prevent conduction of excessive heat from the soldering iron to the component.

d. Through-hole plating breaks are indicated by the separation from the board of the round conductor pad on either side of the board. To repair breaks, press conductor pads against board and solder replacement component lead to conductor pad on both sides of the board.

5-22. MULTIPLIER AMPLIFIER ASSEMBLY A1.

5-23. To remove the Multiplier Amplifier Assembly A1 see Figures 5-2 and 5-3 and proceed as follows:

a. Unscrew the four screws which secure left side plate (MP7) and remove left side plate.

b. Unscrew the four screws which secure top plate (MP6) and remove top plate.

c. Disconnect the following wires from Multiplier Amplifier Assembly A1 (see Figure 5-5):

	From
red	P6(13)
violet	P6(15)
green	P6(50)
red	A5L13
violet	A5L18

d. Disconnect black wire to meter from ground lug on MP14, and white wire to meter from capacitor C3 and MP14.

e. Remove screw securing aluminum spacer rod (MP10) to plug-in guide (MP9) on right side of instrument. Unscrew spacer (MP10) from front panel.

f. Remove the two screws that secure amplifier side plate (MP12) to front panel.

g. Remove the three screws that mount machined amplifier shield (MP14) and slide shield to rear and out the right side to clear board bracket (MP13) from Multiplier Amplifier Assembly A1.

h. Remove the two screws which secure Multiplier Amplifier Assembly to Harmonic Selector Cavity and remove assembly. Note: Harmonic Generator Assembly A2 is mounted to bottom of this assembly.

i. To replace this assembly, reverse the procedure used in steps a through h.

j. All replacement Multiplier Amplifier Assemblies are adjusted at the factory for optimum performance; however, if a general operation check is desired, an in-cabinet performance check is given in Paragraph 5-7.

5-24. HARMONIC GENERATOR ASSEMBLY A2.

5-25. This assembly should be replaced as a unit and no attempt made to repair it. To remove this assembly see Figures 5-2 and 5-3 and proceed as follows:

a. Remove Multiplier Amplifier Assembly A1 as described in Paragraph 5-22.

b. Remove the two harmonic generator mounting screws.

c. Unsolder capacitor C25 from harmonic generator leads (see Figure 5-5).

d. Unsolder harmonic generator leads from Assembly A1 printed circuit board and remove harmonic generator (see Figure 5-5).

e. To replace this assembly reverse the procedure used in steps a through d.

f. The Multiplier Amplifier alignment procedure (Paragraph 5-37) should be performed after replacing Harmonic Generator Assembly.

5-26. HARMONIC SELECTOR CAVITY.

5-27. No attempt should be made to repair the Harmonic Selector Cavity; it should be replaced as a unit. To remove the cavity, see Figures 5-2 and 5-3 and proceed as follows:

a. Remove Multiplier Amplifier Assembly as described in Paragraph 5-22.

b. Remove the four screws that secure cavity plug assembly (MP3) and remove cavity plug and cavity output cable.

c. Unscrew knob set screws and remove knob.

d. Remove the four screws that secure mixing frequency dial and remove dial.

e. Remove the five Harmonic Selector Cavity Mounting screws. Remove cavity by sliding to rear and lifting it out through the left side.

f. To replace this assembly reverse the procedure used in steps a through e.

g. All replacement Harmonic Selector Cavities are adjusted at the factory for optimum performance. However, if a general operation check is desired, and in-cabinet performance check is given in Paragraph 5-7.

5-28. MIXER ASSEMBLY A3.

5-29. No attempt should be made to repair this assembly; it should be replaced as a unit. To remove the assembly, see Figures 5-2 and 5-3 and proceed as follows:

a. Remove the four screws which secure top plate (MP6) and remove top plate.

b. Disconnect black wire to meter from ground lug on MP14 and white wire to meter from capacitor C3 on MP14.

c. Remove screw securing aluminum spacer rod (MP10) to plug-in guide (MP9) on right side of instrument. Unscrew spacer (MP10) from front panel.

d. Remove the twelve screws that secure amplifier side plate (MP12) and remove side plate.

e. Disconnect orange wire from A3R4 and blue wire from A3R3.

f. Slide machined amplifier shield to rear and out the right side to make mixer (A3) and mixer securing screws accessible.

g. Remove the four mixer securing screws. Remove mixer by carefully pulling it out of its cavity in MP14 (machined amplifier shield).

h. To replace the Mixer Assembly A3, reverse the procedure used in steps a through g.

i. The Mixer Balance adjustment, Paragraph 5-40, procedure should be performed after replacing the Mixer Assembly A3).

5-30. FILTER ASSEMBLY A4.

5-31. To remove Filter Assembly A4, see Figures 5-2 and 5-3 and proceed as follows:

a. Remove Mixer Assembly A3 as described in Paragraph 5-28.

b. Pull the Filter Assembly out of its cavity in MP14 with a pair of longnose pliers.

c. To replace this assembly reverse the procedure used in steps a and b.

5-32. VIDEO AMPLIFIER ASSEMBLY A5.

5-33. To remove Video Amplifier Assembly A5, see Figures 5-2 and 5-3 and follow this procedure:

a. Remove the twelve screws that secure the amplifier side plate (MP12) and remove side plate.

b. Disconnect the following wires: 1) the white wire from capacitor C3; 2) the red wire from capacitor C1; 3) the violet wire from capacitor C2; and 4) the two leads from the video amplifier output cables.

c. Remove the five Video Amplifier securing screws and remove the Video Amplifier Assembly A5.

d. To replace the Video Amplifier Assembly A5 reverse the procedure used in steps a thru c.

e. The Mixer Balance Adjust control is on the Video Amplifier Assembly. The replacement of the Video Amplifier Assembly necessitates the adjustment of the Mixer Balance in Paragraph 5-40.

f. All replacement Video Amplifier Assemblies are adjusted at the factory for optimum performance. However, if general operation check is desired, an in-cabinet performance check is given in Paragraph 5-47.

5-34. METER REPLACEMENT PROCEDURE.

5-35. To remove level indicator meter, see Figures 5-2 and 5-3 and proceed as follows:

a. Remove the four screws that secure the top plate (MP6) and remove the top plate.

b. Remove the four screws that secure the side plate (MP7) and remove the side plate.

c. Remove the three screws securing the three aluminum spacer rods (MP10).

d. Unscrew the knob set screws and remove the knob.

e. Remove the four screws that secure the mixing frequency dial and remove dial.

f. Remove the two screws that secure front panel to bottom plate (MP8).

g. Cut connecting wires at meter terminals.

h. Remove panel from instrument to permit access to meter.

i. Remove the two screws from meter bezel at sides of meter. Push bezel forward as far as possible.

j. Grasp meter and gently pull meter (and bracket MP5) backwards out of front panel hole.

k. Remove meter bracket (MP5) and hardware from meter and install in identical manner on replacement meter.

l. Replace meter (with bracket) in unit by reversing procedure used in steps a through k. Strip 1/4 inch insulation from ends of each connecting wire and solder to meter terminals. White wire goes to inside terminal; black wire goes to outside terminal.

5-36. CIRCUIT ADJUSTMENTS.

5-37. MULTIPLIER AMPLIFIER ALIGNMENT PROCEDURE. Two procedures are given for multiplier amplifier alignment; Procedure a is to be used if the multiplier is working and just requires peaking; and Procedure b if the multiplier has no output (check output by measuring dc voltage at junction of C25 and R16; normal reading is 2 volts or more).

a. 1) With counter power off, connect converter to counter with Extension Cable ℔ 10506B.

2) Remove four screws which secure MP6 (top plate) and remove MP6.

3) Set UHF Signal Generator to any frequency between 2 and 3 GC at 50 mv and connect to converter INPUT.

4) Turn counter power on and set controls as shown in Figure 3-1. Tune converter for a maximum indication on Level Indicator Meter.

5) Adjust UHF Signal Generator output level for a reading on the red/green line of the converter Level Indicator Meter.

NOTE: If counter displays a difference frequency below 1 mc, adjust UHF Signal slightly so counter display is between 1 to 50 mc.

6) Adjust A1L2, A1L3, A1L5, A1L6, A1L8, A1L10 and A1C25 for a maximum indication on Level Indicator Meter.

NOTE: If the Level Indicator Meter reading increases to above 1/2 of full scale, readjust the UHF Signal Generator to keep indication near the red/green line.

7) Replace MP6 (top plate).

b. 1) With counter power off, connect converter to counter with Extension Cable ℔ 10506B.

2) Remove four screws which secure MP6 (top plate) and remove MP6.

3) Turn counter power on.

4) Connect ℔ 185B with ℔ 187C plug in (1000 Mc Oscilloscope), using an ℔ 10202B 10:1 Divider and an ℔ 10208A Blocking Capacitor to collector of A1Q1. Set Oscilloscope vertical gain for 5 v/cm (with 10:1 Divider set to .5 v/cm) and horizontal to .05 μs/cm, and trigger oscilloscope from counter OUTPUT STD FREQ 10 Mc (rear of counter).

5) Observe waveform and tune A1L2 for maximum. Waveform and amplitude should approximate that in test point 2, Table 5-4.

6) Connect oscilloscope probe to the collector of A1Q2. Set oscilloscope Vertical to 2 v/cm.

7) Observe waveform and adjust A1L3 for maximum; then adjust A1L5 for maximum. Waveform and amplitude should approximate that in test point 3, Table 5-4.

8) Connect oscilloscope probe to collector of A1Q3.

9) Observe waveform and adjust A1L6 for the approximate waveform and amplitude shown in test point 4, Table 5-4.

10) Connect oscilloscope probe to collector of A1Q4. Set oscilloscope Vertical to 1 v/cm.

11) Observe waveform and adjust A1L8 for maximum. Waveform and amplitude should approximate that shown in test point 5, Table 5-4.

12) Connect oscilloscope probe to collector of A1Q5. Set oscilloscope Vertical to 2 v/cm.

13) Observe waveform and adjust A1L10 for maximum. Waveform and amplitude should approximate that shown in test point 6, Table 5-4.

14) Connect oscilloscope probe to collector of A1Q6. Set oscilloscope Vertical to 10v/cm.

15) Observe waveform and tune A1C25 for maximum. Note two maxima should be noted as the capacitor is turned through 360°. Waveform and amplitude should now approximate that in test point 7, Table 5-4. The output should be a sine wave of 50 Mc, approximately 20 volts amplitude; if not proceed to steps 16 through 19 and then repeat step 15.

16) Adjust capacitor A1C25 to the center of its range (notch perpendicular to axis of leads).

17) Unsolder from the board the end of A1L12 at its junction with A1L11 and A1C23.

18) Observe the waveform and tune A1L12 for a maximum by increasing or reducing the loop diameter. Resolder A1L12 to the board.

19) See Procedure a for final peaking adjustment.

5-38. CRYSTAL FILTER ADJUSTMENT.

5-39. To adjust the cyrstal bandpass filter in the Multiplier Amplifier Assembly A1, proceed as follows:

a. With counter power off, connect converter to counter with Extension Cable ℗10506B.

b. Remove the four screws which secure MP6 (top plate) and remove MP6.

c. Remove the four screws which secure MP7 (left side plate) and remove MP7.

d. Remove Cavity Output Cable Assembly from MP14 (Machined Amplifier Shield). To prevent damage to the cable assembly, first remove the four screws that secure the Cavity Plug Assembly (MP3) and remove the cavity plug and output cable, then unscrew and remove the other end of the output cable from MP14 (Machined Amplifier Assembly). Replace the cavity plug (MP3) and the four screws that secure it to the cavity.

e. Connect a male BNC Plug connector (℗ Stock No. 1250-0052) to the end of the cavity output cable.

f. Using BNC male to Type N female adapter (℗ Stock No. 1250-0077), connect the output cable from Harmonic Selector Cavity to the ℗ Spectrum Analyzer.

g. Set Spectrum Analyzer Controls as follows:

VERTICAL DISPLAY	LOG
IF BANDWIDTH	1 kc
SWEEP TIME	30 ms per cm
IF GAIN	60 db
SPECTRUM WIDTH	100 kc per cm
SYNC	INT
FREQUENCY	2-10 gc
ATTENUATOR	0 DB
SIGNAL IDENTIFIER	OFF

h. Turn counter power ON and turn Converter Mixing Frequency control to 2.95 gc.

i. Tune Spectrum Analyzer until the converter signal is found.

j Observe 100 kc sideband and adjust capacitor (A1C13) for minimum side bands (see Figure 5-1). Side bands should be 30 db below 2.95 gc reference.

5-40. MIXER BALANCE ADJUSTMENT.

a. With counter power off, connect converter to counter with Extension Cable ℗10506B.

b. Remove the twelve screws which secure MP12 (amplifier side plate) and remove MP12.

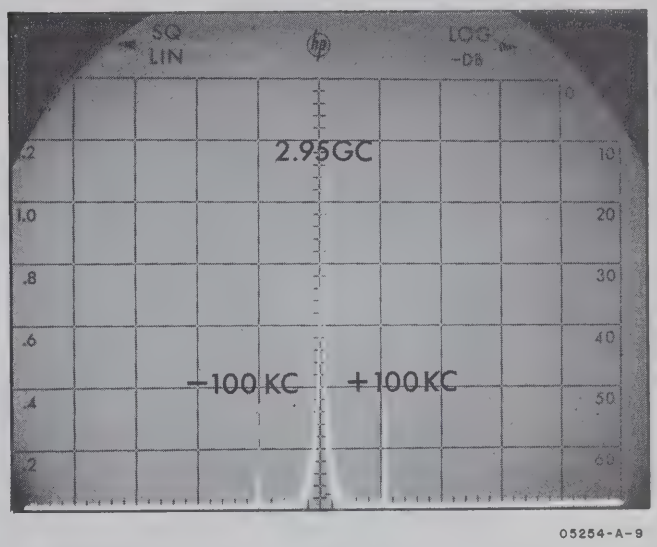


Figure 5-1. Spectrum Analyzer Display

c. Set 608CD Signal Generator to 50 Mc at 30 mv rms and connect to INPUT of converter.

d. Turn counter power ON and adjust Mixer Balance Adjust A5R3 for a minimum reading on the level indicator meter.

5-41. LOW PASS FILTER ADJUSTMENT.

5-42. The Low Pass Filter in the Video Amplifier Assembly A5 consists of three resonant LC parallel circuits (see schematic diagram, Figure 5-9). These circuits are pre-tuned and sealed at the factory, and should need no further adjustment. The following procedure can be used to verify correct operation of the filter circuits (A5L1, A5L2, and A5L3) and to check the tuning of replacement circuits.

a. Remove circuits (A5L1, A5L2, and A5L3) from the Video Amplifier Assembly board.

b. Install clips on terminals of RX Meter. Clamp one leg of the circuit under test with the clip from the LO side. Bring other leg close to but not touching the clip on HI side.

c. Depending on which circuit is under test, the frequency should be set to the following:

A5L1	117.3 Mc
A5L2	71.9 Mc
A5L3	63.2 Mc

d. Tune in instrument with "Detector tuning adjustments" and maximize response, with R_p and C_p set to arbitrary values.

e. Set R_p to "infinity" and C_p to zero.

f. Null the response with the Zero Balance adjustments.

g. Clamp the other leg to the HI side clip.

h. Leave C_p at zero; alternately tune the circuit with tuning wand and adjust R_p dial until a null is obtained.

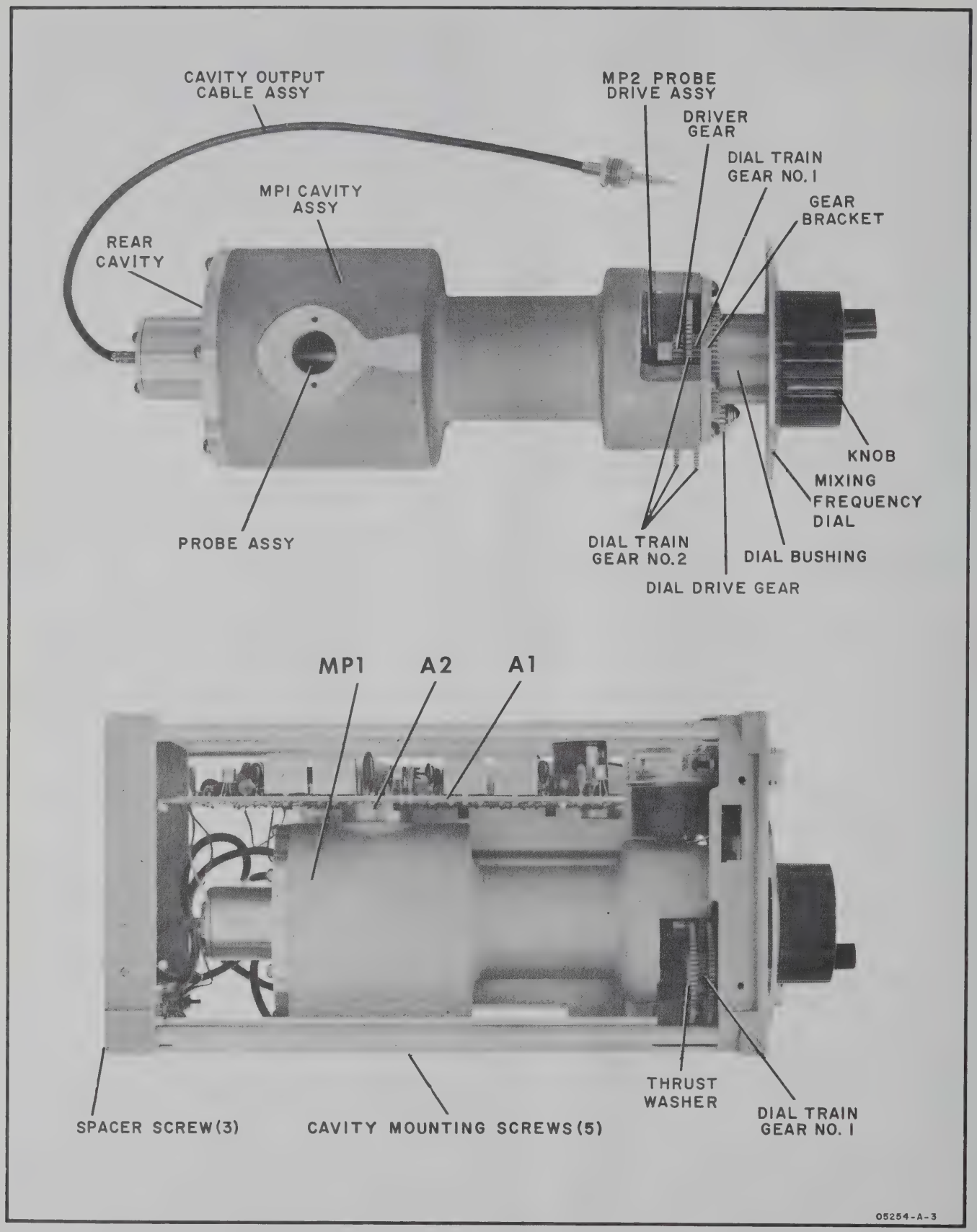


Figure 5-2. Cavity and Left Side View

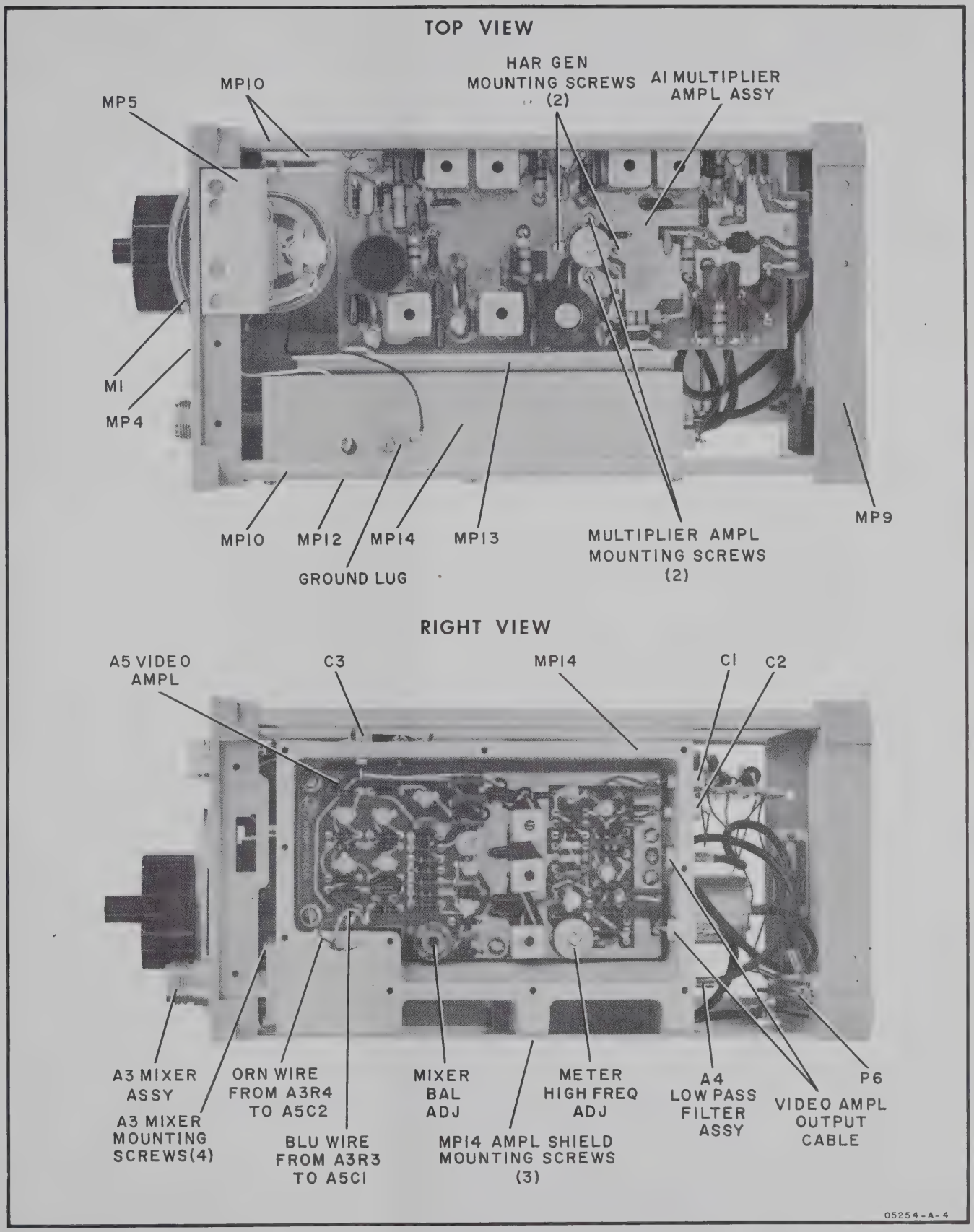


Figure 5-3. Top and Right Side View

5-43. METER AMPLIFIER HIGH FREQUENCY ADJUSTMENT.

a. With counter power off, connect converter to counter with Extension Cable ℗ 10506B.

b. Remove the twelve screws which secure MP12 (amplifier side plate) and remove MP12.

c. Set 608CD Signal Generator to 450 Mc at 50 mv and connect to INPUT of converter.

d. Connect RF Millivoltmeter, through a 50-ohm feedthrough termination to the AUXILIARY A (TIME INTERVAL START) output on the rear of the 5245L.

e. Turn counter power ON, and tune the converter for an indication at . 4 Gc; the counter should display 50 Mc to 51 Mc. If not, adjust the Signal Generator frequency slightly so that it does.

f. Adjust the output level of the Signal Generator for a reading of 95 mv on the RF Millivoltmeter.

g. Adjust the Meter High Frequency adjust capacitor A5C19 until Level Indicator Meter reads on the red/green line.

Table 5-4. In-Cabinet Performance Check

1. RANGE: 300 to 3000 Mc

a. Set Counter controls as follows:

SAMPLE RATE	slightly clockwise out of POWER OFF
SENSITIVITY	PLUG IN
TIME BASE	100 ms
FUNCTION	FREQUENCY
FREQUENCY CONVERTER DIAL	300 Mc

b. Connect VHF Signal Generator to plug-in. Set output level of Generator to 0.05v rms (0.014v peak-to-peak).

c. Vary frequency from 300 Mc to 450 Mc, keeping the output constant at 0.05v rms (0.014v peak-to-peak). Reading of plug-in dial and Counter display should be correct frequency. Tune Converter for maximum signal indication.

d. Substitute UHF Signal Generator for VHF Signal Generator.

e. Vary frequency from 450 Mc to 1200 Mc, keeping output constant at 0.05v rms (0.014v peak-to-peak). Note frequency reading. Converter must be tuned for maximum signal indication.

f. Substitute the 800 Mc to 2400 Mc Generator for the 450 Mc to 1230 Mc Generator

g. Vary the frequency from 1200 Mc to 2400 Mc, keeping the output constant at 0.05v rms (0.014v peak-to peak). Note frequency readings. Converter must be tuned for maximum signal indication.

h. Substitute 1.8 Gc to 4.6 Gc Generator for the 1200 Mc to 2400 Mc Generator.

i. Vary frequency from 2400 Mc to 3 Gc, keeping the output constant at 0.05v rms (0.014v peak-to-peak). Record frequency range steps c, e, g, and i on test card.

Table 5-4. In-Cabinet Performance Check (Cont'd)

2. INPUT SIGNAL LEVEL: 50 mv rms (-13 dbm in 50 ohms) to 1v rms (+13 dbm in 50 ohms).

a. Input signal level specification is verified by procedure 1, RANGE check.

3. ACCURACY: Same as basic Counter.

a. A special system is used to check the accuracy of the 5254A plug-in. A 107BR is used as the time base for the system. The 1 Mc is connected to the EXT TIME BASE inputs of the 5245L and 5275A. The 10 Mc output of the 5245L is used as the IF reference for the DY-2650A. A12, 100 Mc decade, is removed from the 5275A. The 100 Mc signal is taken from A5 pin 13 of the 5275A and is connected to V13 pin 1. Pull the tube and connect the 100 Mc signal through a 10 pf capacitor. The 8616A is connected to the DY-2650A as described in the 8616A manual. Connect the output of the 8616A to the input of the 5245L plug-in.

b. Locking frequencies can be calculated by the following formula:

$$f_o = Nf_{rf} \pm f_{if}$$

where f_o = klystron frequency

f_{rf} = rf reference frequency which is 200 Mc (i.e., double the rf xtal frequency)

N = harmonic number which can range from 5 to 60 or more.

f_{if} = if reference frequency which can be 30 Mc

for example:

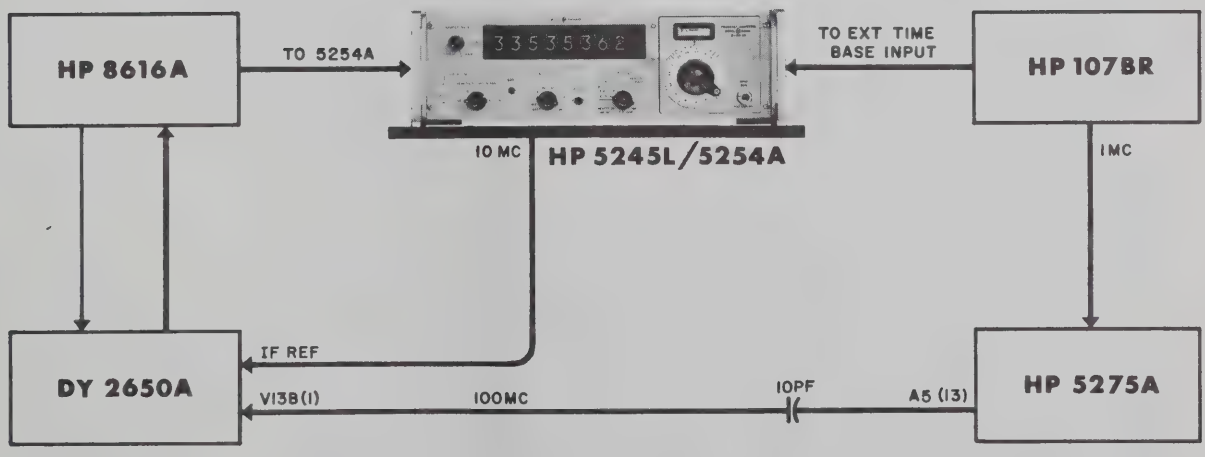
$N = 15$, $f_{rf} = 20$ Mc, $f_{if} = \pm 30$ Mc

$f_o = 15 \times 200$ Mc ± 30 Mc

$f_o = 3000$ Mc ± 30 Mc

$f_o = 2970$ Mc or 3030 Mc

the system should lock on these frequencies.



c. Set Counter controls as follows:

SAMPLE RATE	slightly clockwise out of POWER OFF
SENSITIVITY	PLUG IN
TIME BASE	1 s
FUNCTION	FREQUENCY

d. Tune Signal Generator until it is phase locked with the Oscillator Synchronizer.

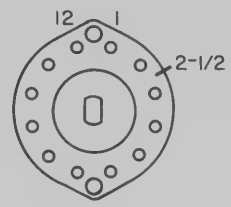
e. Tune Frequency Converter for maximum inidication on signal level meter.

f. Read frequency on counter, add or subtract 30 Mc, and compare with calculated frequency.

SYMBOLS

- FRONT PANEL
- REAR PANEL
- KNOB CONTROL
- SCREWDRIVER ADJUST
- MAIN SIGNAL PATH
- FEEDBACK PATH
- CONDUCTING ELEMENT
- CW — WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE
- POWER LINE GROUND
- CIRCUIT COMMON GROUND
- TEST POINT
- A — "AND" GATE
- I — INHIBIT GATE
- O — "OR" GATE
- WAVEFORMS SHOWN ARE TYPICAL

SWITCH DESIGNATIONS



A3S1BR(2-1/2)

A3S1 — SWITCH S1 WITHIN ASSEMBLY A3

B — 2ND WAFER FROM FRONT (A=1ST, ETC)

R — REAR OF WAFER (F=FRONT)

(2-1/2) — TERMINAL LOCATION ($2\frac{1}{2}$) (VIEWED FROM FRONT)

REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

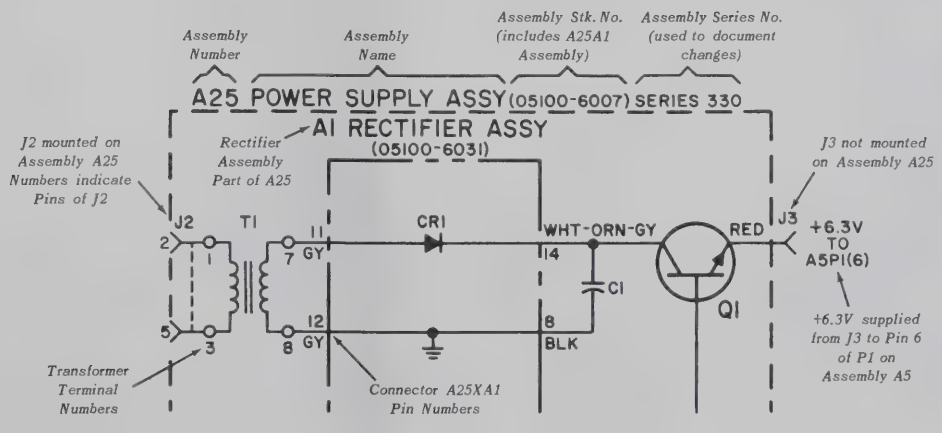


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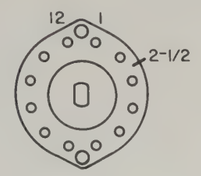
Figure 5-4. Schematic Diagram Notes

SYMBOLS

- FRONT PANEL
- REAR PANEL
- KNOB CONTROL
- SCREWDRIVER ADJUST
- MAIN SIGNAL PATH
- FEEDBACK PATH
- CONDUCTING ELEMENT
- WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE
- POWER LINE GROUND
- CIRCUIT COMMON GROUND
- TEST POINT
- "AND" GATE
- INHIBIT GATE
- "OR" GATE

WAVEFORMS SHOWN ARE TYPICAL

SWITCH DESIGNATIONS



A3S1BR(2-1/2)

A3S1 SWITCH S1 WITHIN ASSEMBLY A3

B 2ND WAFER FROM FRONT (A=1ST, ETC)

R REAR OF WAFER (F=FRONT)

(2-1/2) TERMINAL LOCATION ($2\frac{1}{2}$) (VIEWED FROM FRONT)

REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

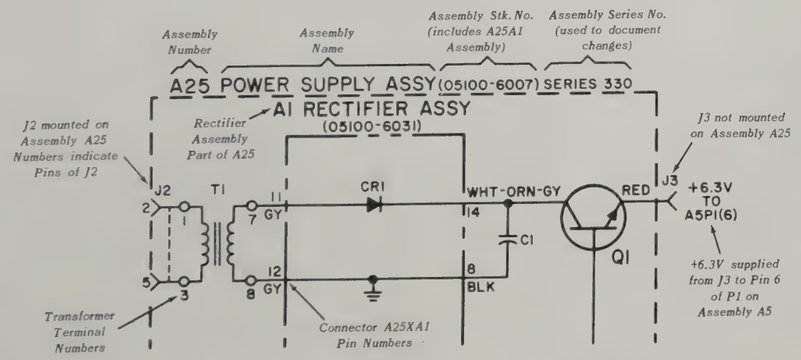


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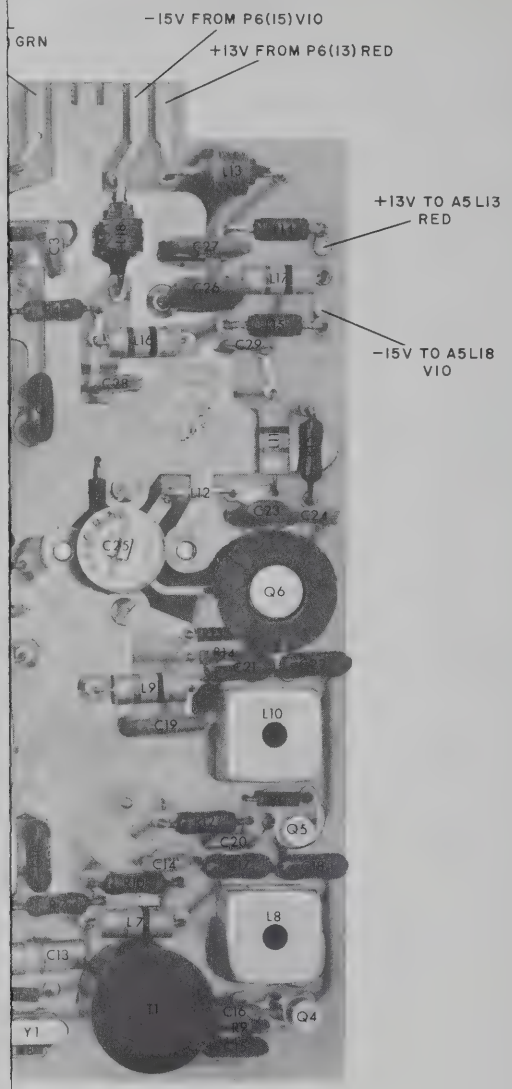
Figure 5-4. Schematic Diagram Notes

TP	STAGE	AVERAGE DC VOLTAGE E	C	B	APPROX. AMPLITUDE VOLTS P/P WAVEFORM
1	INPUT	DC VOLTAGE +7.5			4 V, 100 ns
2	A1Q1	+1.13	+12.4	-.048	24 V, 100 ns
3	A1Q2	+2.7	+12.4	0	7 V, 100 ns
4	A1Q3	+.227	+9.1	0	2 V, 20 ns, 100 ns
5	A1Q4	-.65	+12.4	0	1.4 V, 20 ns
6	A1Q5	-.83	+12.4	-.23	5 V, 20 ns
7	A1Q6	-2.84	12.3	-2.44	20 V, 20 ns
	A5Q1	+4.0	-1.6	+3.7	
	A5Q2	+4.0	-1.3	+3.7	
	A5Q3	-1.3	-9.0	-1.6	
	A5Q4	-1.05	-8.3	-1.35	
8	A5Q5	-9.0	- .32	-8.3	15MV
9	A5Q6	0	-9.7	-.3	120MV
10	A5Q7	-10.5	0	-9.7	70MV
11	A5Q8	-9.7	+.28	-9	70MV
12	LOW PASS FILTER OUTPUT				80MV
13	A5Q9	0	+5.9	+.7	450MV
14	A5Q10	-5.2	+12.5	+5.9	450MV
15	A5Q11	+4.5	+11.0	+5.2	1.2V
16	A5Q12	+5.5	-4.3	+5.2	375MV
17	A5Q12	+5.5	-4.3	+5.2	400MV
18	OUTPUT TO COUNTER — 1 Mc DIFFERENCE SIGNAL AT 50mv				410MV, 1MC
	OUTPUT TO COUNTER — 50Mc DIFFERENCE SIGNAL AT 50mv				415MV, 50MC
19	EXTERNAL OUTPUT — 1 Mc DIFFERENCE SIGNAL AT 50mv				DEPENDS ON TERMINATION, 220MV, 1MC
	EXTERNAL OUTPUT — 50Mc DIFFERENCE SIGNAL AT 50mv				DEPENDS ON TERMINATION, 220MV, 50MC

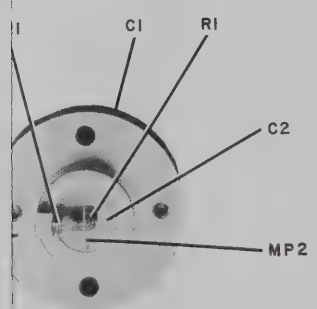
05254-B-3

NOTE: WAVEFORMS TAKEN USING -HP-185B WITH -HP-187C, -HP-10202B AND -HP-10208A

Table 5-5. Troubleshooting Aids



A1



(Bottom of A1)

05254-A-5

ssembly A1, and
onent Location

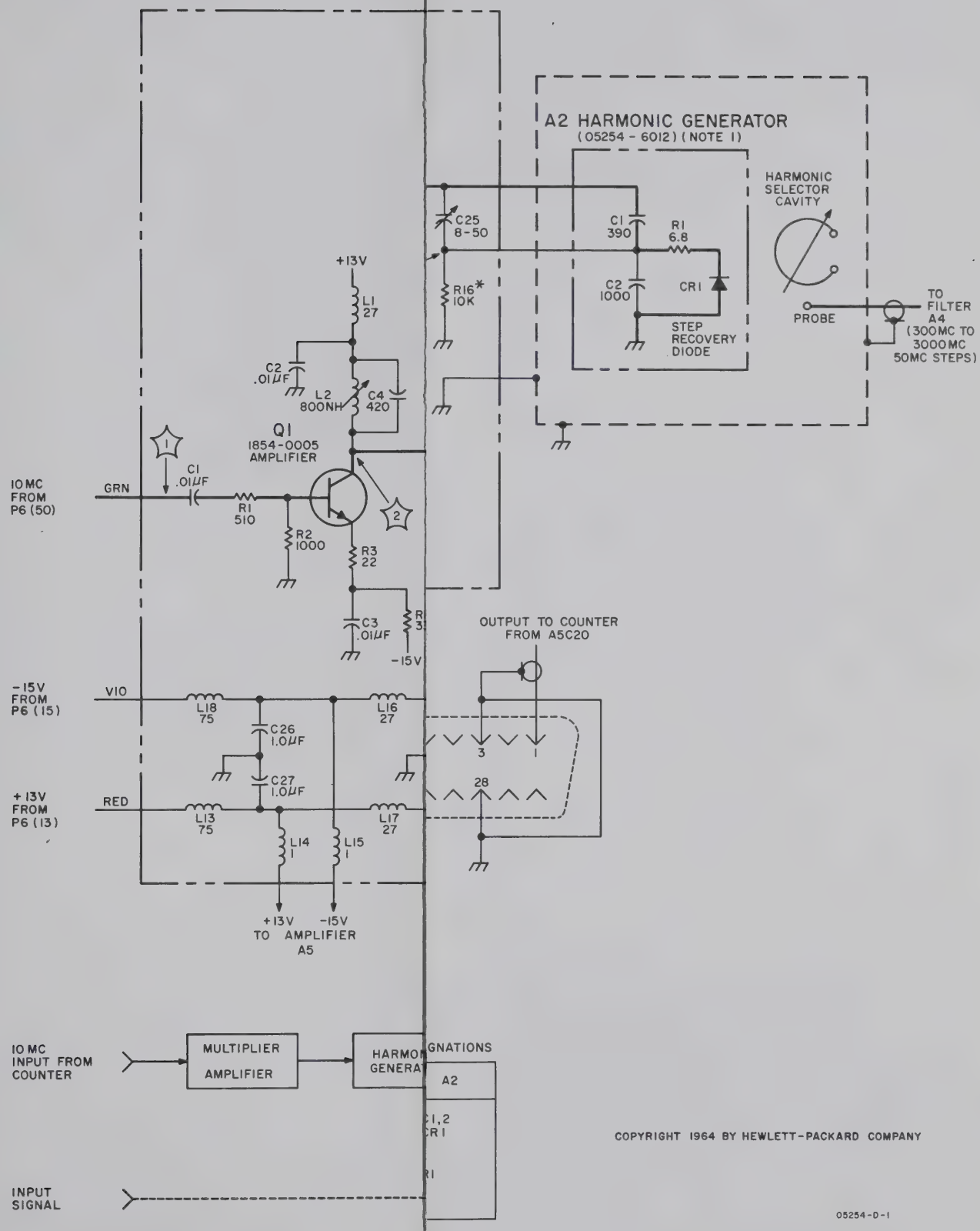
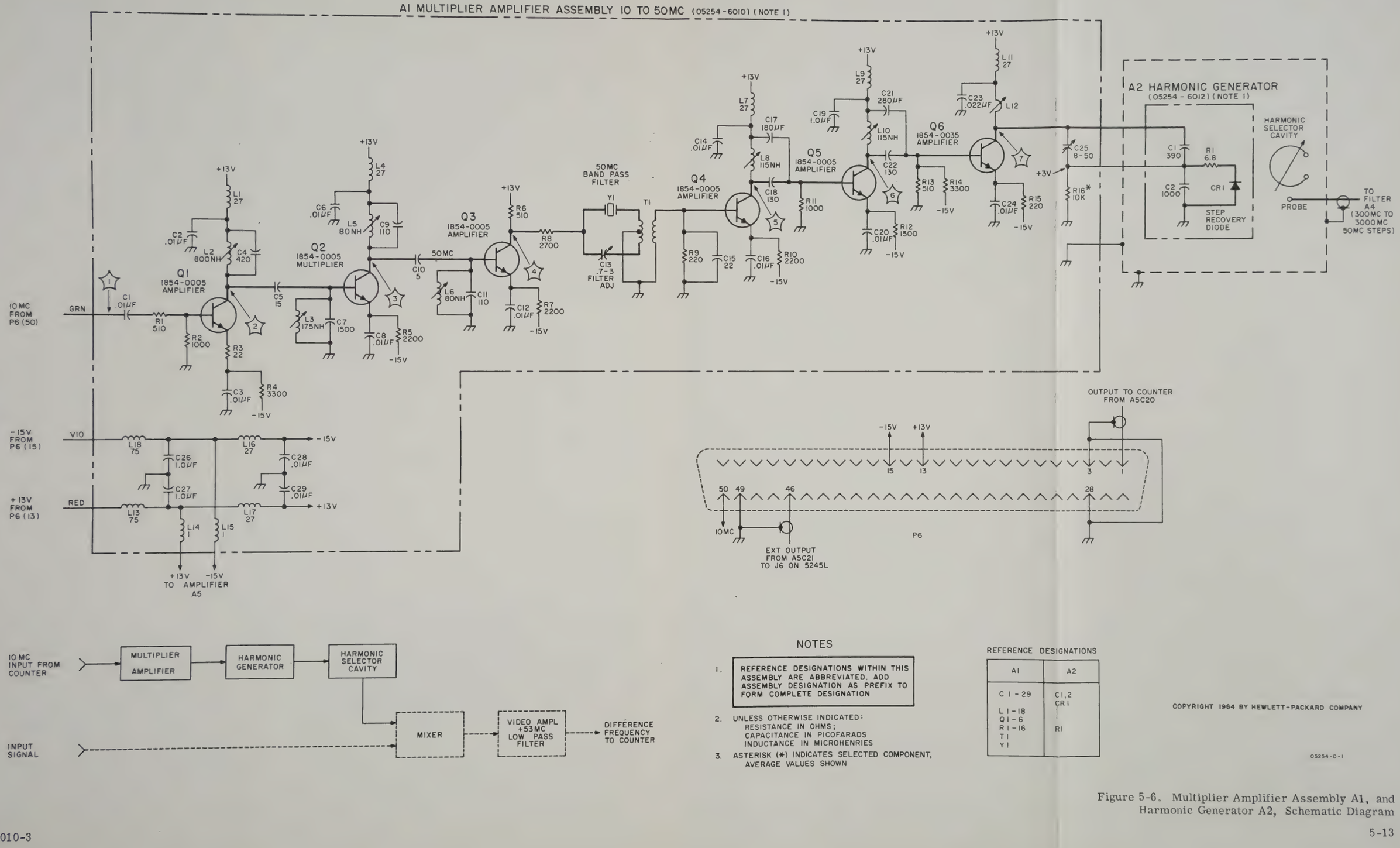


Figure 5-6. Multiplier Amplifier Assembly A1, and Harmonic Generator A2, Schematic Diagram



NOTES

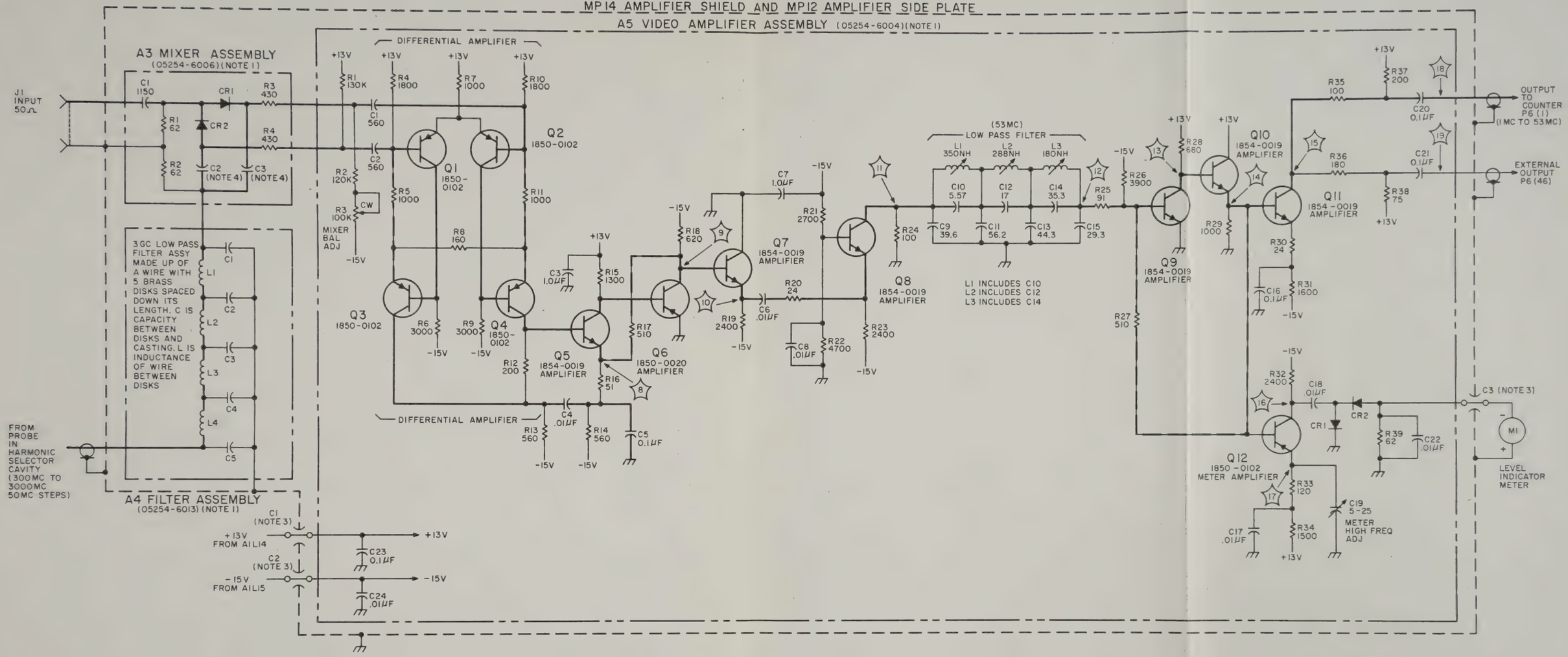
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

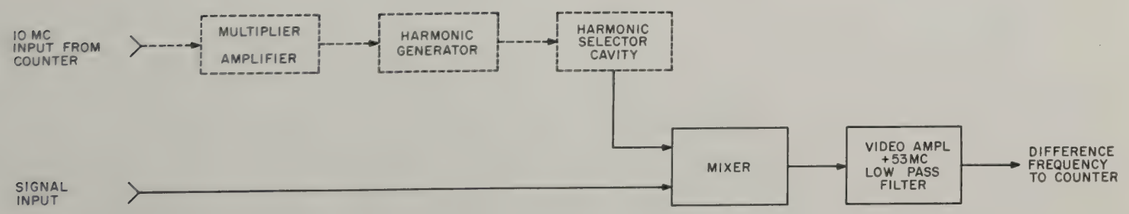
REFERENCE DESIGNATIONS

A1	A2
C 1 - 29 L 1 - 18 Q 1 - 6 R 1 - 16 T 1 Y 1	C1,2 CR 1 R1

05254-D-1

Figure 5-6. Multiplier Amplifier Assembly A1, and Harmonic Generator A2, Schematic Diagram





NOTES

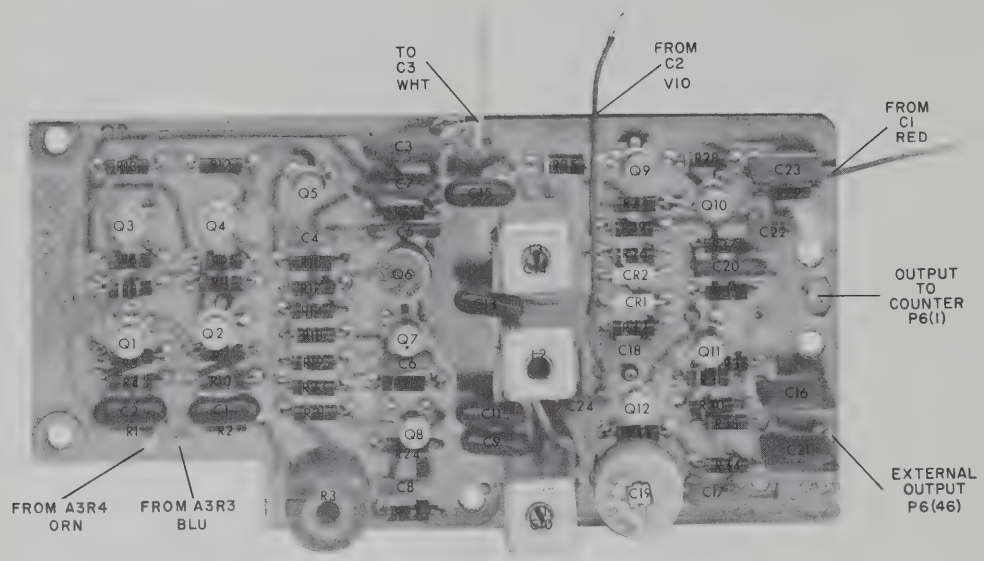
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS
   INDUCTANCE IN MICROHENRIES
3. C1,C2,C3 ARE CAPACITIVE FEED THROUGH FILTER NETWORKS
4. A3C2, A3C3 ARE CONDUCTOR CAPACITORS CONSISTING OF TEFLON TUBING OVER THE CONDUCTOR

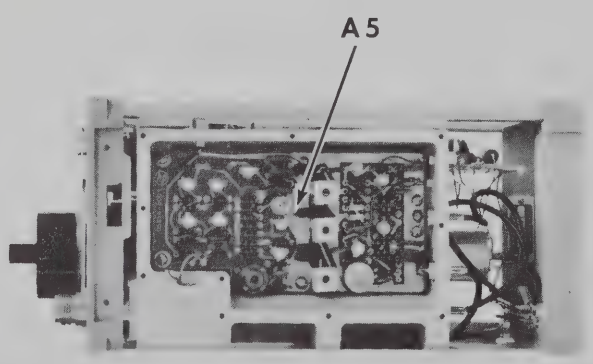
REFERENCE DESIGNATIONS

NO PREFIX	A3	A4	A5
C1-3	C1-3	C1-5	C1-24
	CR1,2		CR1,2
J1			
		L1-4	L1-3
M1			
MP12,14			
			Q1-12
	R1-4		R1-39

05254-D-2A

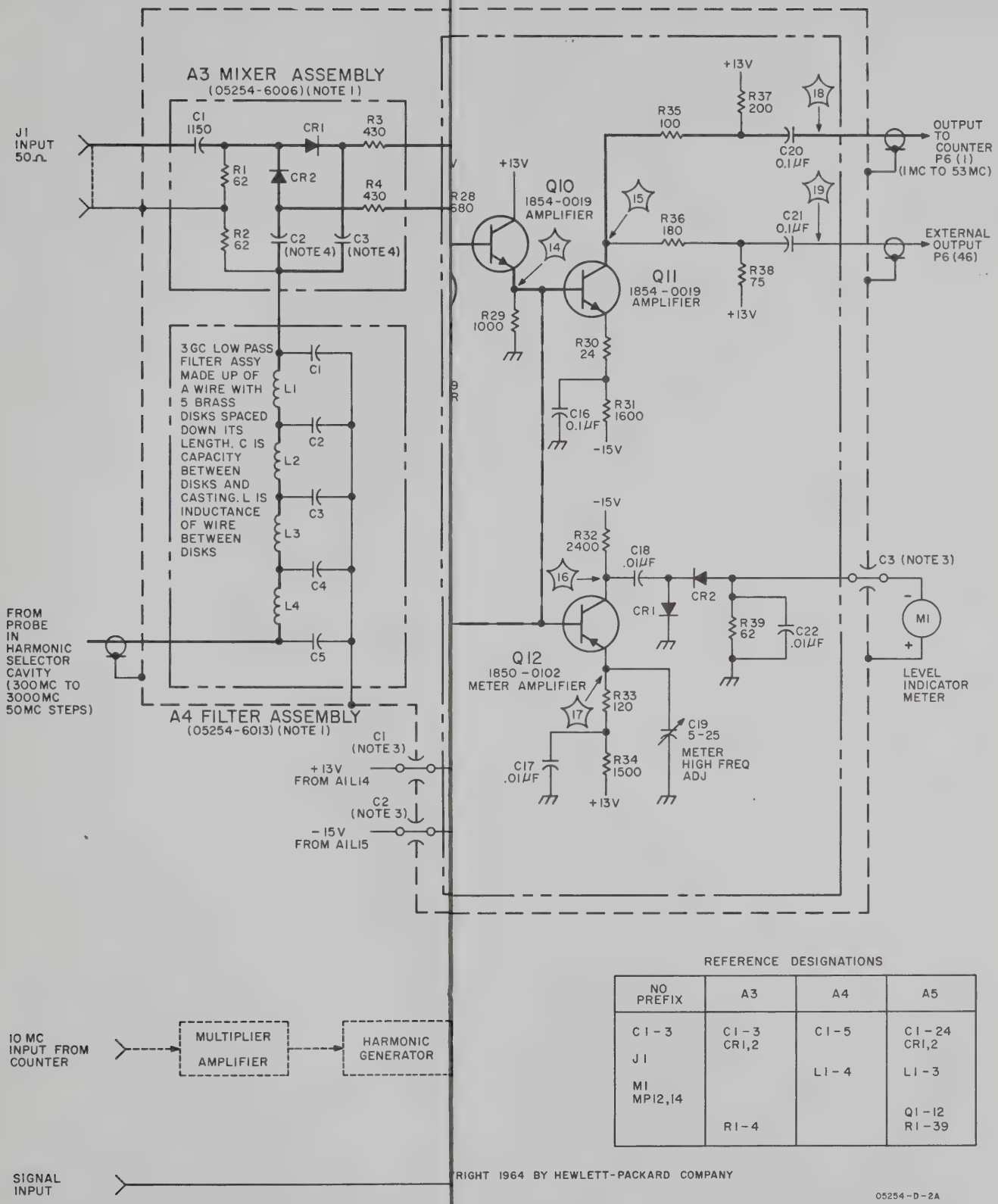
Figure 5-9. Filter Assembly A4, Mixer Assembly A3, and Video Amplifier Assembly A5, Schematic Diagram





05254-A-7

Figure 5-8. Video Amplifier Assembly A5
Component Location

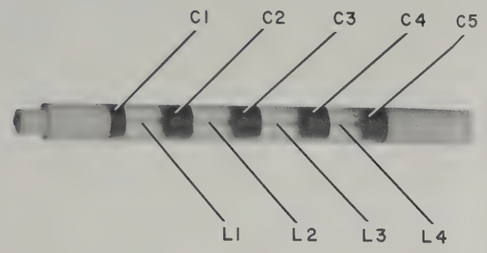


REFERENCE DESIGNATIONS

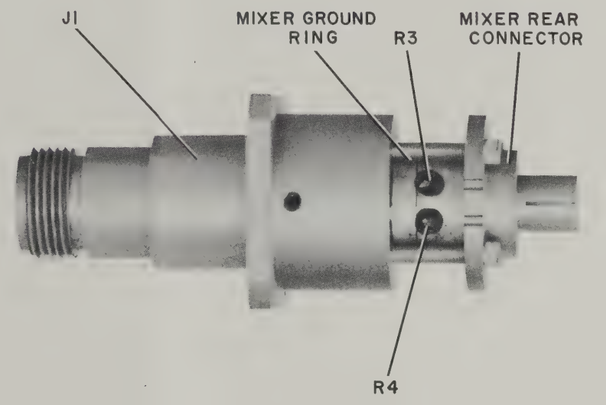
NO PREFIX	A3	A4	A5
C1-3	C1-3	C1-5	C1-24
	CR1,2		CR1,2
J1			
		L1-4	L1-3
M1			
MP12,14			
			Q1-12
	R1-4		R1-39

05254-D-2A

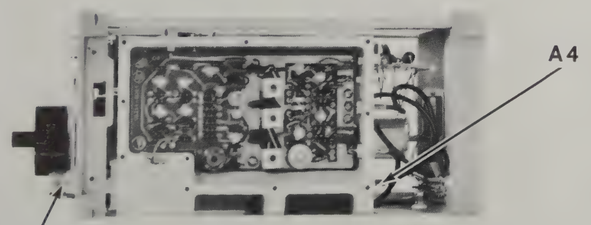
Figure 5-9. Filter Assembly A4, Mixer Assembly A3, and Video Amplifier Assembly A5, Schematic Diagram



A4

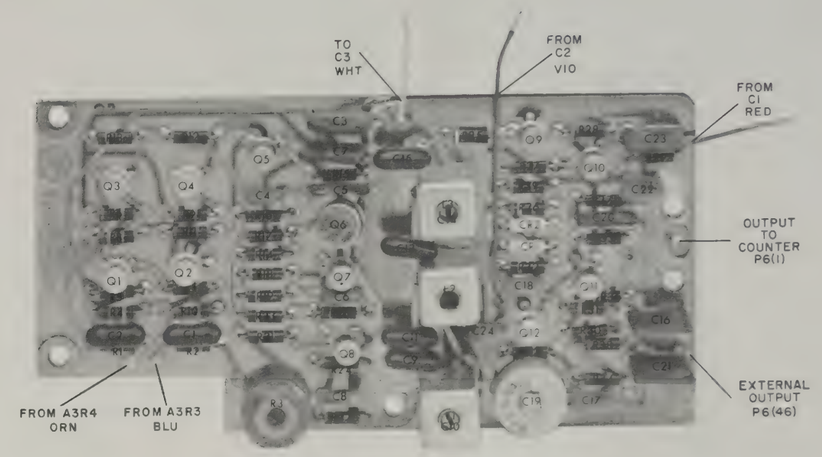


A3

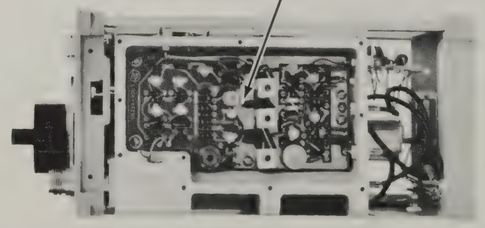


05254-A-6

Figure 5-7. Filter Assembly A4, and Mixer Assembly A3, Component Location



A5



05254-A-7

Figure 5-8. Video Amplifier Assembly A5 Component Location

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designators and indicates the description and hp stock number of each part, together with any applicable notes. Table 6-2 lists parts in alpha-numerical order of their hp stock number and provides the following information on each part:

a. Description of the part (see list of abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-3.

c. Manufacturer's part number.

d. Total quantity used in the instrument (TQ column).

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION.

6-5. To order a replacement part, address order or inquiry to your local Hewlett-Packard Field Office (see lists at rear of this manual for addresses).

6-6. Specify the following information for each part:

a. Model and complete serial number of instrument.

b. Hewlett-Packard stock number.

c. Circuit reference designator.

d. Description.

6-7. To order a part not listed in Tables 6-1 and 6-2, give a complete description of the part and include its function and location.

REFERENCE DESIGNATORS

A = assembly	E = misc electronic part	MP = mechanical part	TB = terminal board
B = motor	F = fuse	P = plug	TP = test point
C = capacitor	FL = filter	Q = transistor	V = vacuum tube, neon
CP = coupling	J = jack	R = resistor	bulb, photocell, etc.
CR = diode	K = relay	RT = thermistor	W = cable
DL = delay line	L = inductor	S = switch	X = socket
DS = device signaling (lamp)	M = meter	T = transformer	Y = crystal

ABBREVIATIONS

A = amperes	GE = germanium	N/C = normally closed	RMO = rack mount only
A.F.C = automatic frequency control	GL = glass	NE = neon	RMS = root-mean-square
AMPL = amplifier	GRD = ground(ed)	NI PL = nickel plate	
		N/O = normally open	S-B = slow-blow
B.F.O. = beat frequency oscillator	H = henries	NPO = negative positive zero	SCR = screw
BE CU = beryllium copper	HEX = hexagonal	(zero temperature	SE = selenium
BH = binder head	HG = mercury	coefficient)	SECT = section(s)
BP = bandpass	HR = hour(s)	NRFR = not recommended for	SEMICON = semiconductor
BRS = brass		field replacement	SI = silicon
BWO = backward wave oscillator	IF = intermediate freq	NSR = not separately	SIL = silver
	IMPG = impregnated	replaceable	SL = slide
CCW = counter-clockwise	INCD = incandescent		SPL = special
CER = ceramic	INCL = include(s)	OBD = order by description	SST = stainless steel
CMO = cabinet mount only	INS = insulation(ed)	OH = oval head	SR = split ring
COEF = coefficient	INT = internal	OX = oxide	STL = steel
COM = common			
COMP = composition	K = kilo = 1000	P = peak	TA = tantalum
CONN = connector		PC = printed circuit	TD = time delay
CP = cadmium plate	LIN = linear taper	PF = picofarads =	TGL = toggle
CRT = cathode-ray tube	LK WASH = lock washer	10^{-12} farads	TI = titanium
CW = clockwise	LOG = logarithmic taper	PH BRZ = phosphor bronze	TOL = tolerance
	LPF = low pass filter	PHL = Phillips	TRIM = trimmer
DEPC = deposited carbon		PIV = peak inverse voltage	TWT = traveling wave tube
DR = drive	M = milli = 10^{-3}	P/O = part of	
	MEG = meg = 10^{6}	POLY = polystyrene	U = micro = 10^{-6}
ELECT = electrolytic	METFLM = metal film	PORC = porcelain	
ENCAP = encapsulated	MFR = manufacturer	POS = position(s)	VAR = variable
EXT = external	MINAT = miniature	POT = potentiometer	VDCW = dc working volts
	MOM = momentary	PP = peak-to-peak	
F = farads	MTG = mounting	PT = point	W/ = with
FH = flat head	MY = "mylar"	RECT = rectifier	W = watts
FIL H = fillister head		RF = radio frequency	WW = wirewound
FXD = fixed	N = nano (10^{-9})	RH = round head	W/O = without

01194-9

Table 6-1. Reference Designation Index

Circuit Reference	Stock No.	Description	Note
A1	05254-6010	MULTIPLIER AMPLIFIER ASSEMBLY(INCLUDES A2,05254-6012)	
	05254-2044	BLANK PRINTED CIRCUIT BOARD	
A1C1	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C2	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C3	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C4	0140-0230	C:FXD MICA 420 PF 1%	
A1C5	0140-0202	C:FXD MICA 15 PF 5% 500VDCW	
A1C6	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C7	0140-0156	C:FXD MICA 1500 PF 2% 300VDCW	
A1C8	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C9	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
A1C10	0140-0209	C:FXD MICA 5 PF 10%	
A1C11	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
A1C12	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C13	0132-0003	C:VAR TRIMMER 0.7-3.0 PF	
A1C14	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C15	0140-0145	C:FXD MICA 22 PF 5% 500VDCW	
A1C16	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C17	0140-0219	C:FXD MICA 180 PF 2%	
A1C18	0140-0195	C:FXD MICA 130 PF 5% 300VDCW	
A1C19	0160-0127	C:FXD CER 1.0 UF 20% 25VDCW	
A1C20	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C21	0140-0224	C:FXD MICA 280 PF 1%	
A1C22	0140-0195	C:FXD MICA 130 PF 5% 300VDCW	
A1C23	0170-0083	C:FXD MY 0.022 UF 20% 50VDCW	
A1C24	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C25	0130-0017	C:VAR CER 8-50 UF N750	
A1C26	0160-0127	C:FXD CER 1.0 UF 20% 25VDCW	
A1C27	0160-0127	C:FXD CER 1.0 UF 20% 25VDCW	
A1C28	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C29	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1L1	9140-0107	COIL:FXD RF 27 UH	
A1L2	9140-0221	COIL:VAR TUNABLE 800 NH	
A1L3	9140-0220	COIL:VAR TUNABLE 175 NH	
A1L4	9140-0107	COIL:FXD RF 27 UH	
A1L5	9140-0218	COIL:VAR TUNABLE 80 NH	
A1L6	9140-0218	COIL:VAR TUNABLE 80 NH	
A1L7	9140-0107	COIL:FXD RF 27 UH	
A1L8	9140-0219	COIL:VAR TUNABLE 115 NH	
A1L9	9140-0107	COIL:FXD RF 27 UH	
A1L10	9140-0219	COIL:VAR TUNABLE 115 NH	
A1L11	9140-0107	COIL:FXD RF 27 UH	
A1L12	8151-0012	WIRE:#20 AWG (1-1/2")	
A1L13	9140-0031	COIL:RF 75 UH	
A1L14	9140-0018	COIL:RF 1 UH	
A1L15	9140-0018	COIL:RF 1 UH	
A1L16	9140-0107	COIL:FXD RF 27 UH	
A1L17	9140-0107	COIL:FXD RF 27 UH	
A1L18	9140-0031	COIL:RF 75 UH	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	℗ Stock No.	Description	Note
A1Q1 THRU			
A1Q5	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A1Q6	1854-0035	TRANSISTOR:SILICON NPN	
	1205-0011	HEAT SINK FOR TO-5 AND TO-9 CASE	
A1R1	0683-5115	R:FXD COMP 510 OHM 5% 1/4W	
A1R2	0683-1025	R:FXD COMP 1K OHM 5% 1/4W	
A1R3	0683-2205	R:FXD COMP 22 OHM 5% 1/4W	
A1R4	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A1R5	0758-0044	R:FXD MET OX 2.2K OHM 5% 1/2W	
A1R6	0683-5115	R:FXD COMP 510 OHM 5% 1/4W	
A1R7	0758-0044	R:FXD MET OX 2.2K OHM 5% 1/2W	
A1R8	0683-2725	R:FXD COMP 2.7K OHM 5% 1/4W	
A1R9	0683-2215	R:FXD COMP 220 OHM 5% 1/4W	
A1R10	0758-0044	R:FXD MET OX 2.2K OHM 5% 1/2W	
A1R11	0683-1025	R:FXD COMP 1K OHM 5% 1/4W	
A1R12	0758-0017	R:FXD MET FLM 1500 OHM 5% 1/2W	
A1R13	0683-5115	R:FXD COMP 510 OHM 5% 1/4W	
A1R14	0683-3325	R:FXD COMP 3.3K OHM 5% 1/4W	
A1R15	0758-0015	R:FXD MET FLM 220 OHM 5% 1/2W	
A1R16	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	*
A1T1	05254-6011	TOROID ASSEMBLY:WOUND	
A1Y1	0410-0089	CRYSTAL:50 MC .004%	
MISC	0890-0001	TUBING:1/2"	
A2	05254-6012	HARMONIC GENERATOR ASSEMBLY:PARTS IN THIS ASSEMBLY, NOT RECOMMENDED FOR FIELD REPLACEMENT	
A2C1	0160-0958	C:FXD MICA 390 PF 5% 300VDCW	*
A2C2	0160-0759	C:FXD MICA 1000 PF 5% 250VDCW	*
A2CR1	1901-0153	SEMICON DEVICE:DIODE SILICON	*
A2MP1	05254-2039	DIODE MOUNT	*
A2MP2	05254-0008	SUPRESSOR-MODE	*
A2R1	0758-0135	R:FXD DEPC 6.8 OHM 10% 1/10W(PELLET RESISTOR)	*
A3	05254-6006	MIXER ASSEMBLY:PARTS IN THIS ASSEMBLY, NOT RECOMMENDED FOR FIELD REPLACEMENT	
A3C1	05254-4001	CAPACITOR ASSEMBLY:INPUT	*
A3C2	05254-2037	PART OF CONDUCTOR,CAPACITOR	*
A3C3	05254-2037	PART OF CONDUCTOR,CAPACITOR	*
	0890-0297	TUBING,TEFLON 1/2" P/O C2 &C3	*
A3CR1	1900-0014	DIODE-POINT CONTACT,SILICON,MATCHED SET	*
A3CR2	1900-0014	DIODE-POINT CONTACT,SILICON,MATCHED SET	*
A3J1	05254-2027	CONNECTOR:INPUT	*
A3R1	0757-0895	R:FXD MET OX 62 OHM 2% 1/8W	*
A3R2	0757-0895	R:FXD MET OX 62 OHM 2% 1/8W	*
A3R3	0758-0125	R:FXD MET FLM 430 OHM 5% 1/4W	*
A3R4	0758-0125	R:FXD MET FLM 430 OHM 5% 1/4W	*
		*NOT RECOMMENDED FOR FIELD REPLACEMENT	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	Stock No.	Description	Note
A3		MISCELLANEOUS	
	0460-0055	TAPE:TEFLON 1/2"	*
	0890-0009	TUBING:1/2"	*
	3030-0149	SET SCREW:#0-80 X 3/32"	*
	05254-2008	CAPACITOR MOUNT:MIXER	*
	05254-2009	CONTACT:MIXER	*
	05254-2011	INSERT:MIXER OUTPUT	*
	05254-2012	CONNECTOR:REAR,MIXER	*
	05254-2038	RING:MIXER GROUND	*
	05254-2041	STUD:THREADED	*
A4	05254-6013	RF FILTER ASSEMBLY:PARTS IN THIS ASSEMBLY, NOT RECOMMENDED FOR FIELD REPLACEMENT	
A4C1	05254-2045	FILTER SECTION II,METAL DISK	*
A4C2	05254-2047	FILTER SECTION III,METAL DISK	*
A4C3	05254-2046	FILTER SECTION II,METAL DISK	*
A4C4	05254-2047	FILTER SECTION III,METAL DISK	*
A4C5	05254-2045	FILTER SECTION I,METAL DISK	*
A4L1 THRU A4L4	360A-13	WIRE-CENTER CONDUCTOR	*
A4MP1	05254-2010	INSERT:FRONT AMPLIFIER	*
A4MP2	05254-2004	INSERT:REAR AMPLIFIER	*
A4MP3	05254-2048	SLEEVE:RF FILTER	*
		MISCELLANEOUS	
	05254-2050	SPACER:FILTER TERMINATION	*
	1250-0020	CONTACT:BNC FEMALE	*
A5	05254-6004	VIDEO AMPLIFIER ASSEMBLY	
	05254-2043	BLANK PRINTED CIRCUIT BOARD	
A5C1	0140-0178	C:FXD MICA 560 PF 2% 300VDCW	
A5C2	0140-0178	C:FXD MICA 560 PF 2% 300VDCW	
A5C3	0160-0127	C:FXD CER 1.0 UF 20% 25VDCW	
A5C4	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A5C5	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A5C6	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A5C7	0160-0127	C:FXD CER 1.0 UF 20% 25VDCW	
A5C8	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A5C9	0160-0740	C:FXD MICA 39.6 PF 500VDCW	
A5C10		C:FXD 5.57 PF,N.S.R. PART OF L1	
A5C11	0160-0739	C:FXD MICA 56.2 PF	
A5C12		C:FXD 17 PF ,N.S.R. PART OF L2	
A5C13	0160-0738	C:FXD MICA 44.3 PF	
A5C14		C:FXD 35.3 PF, N.S.R. PART OF L3	
A5C15	0160-0737	C:FXD MICA 29.3 PF	
A5C16	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A5C17	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A5C18	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A5C19	0130-0016	C:VAR CER 5-25 PF NPO	
A5C20	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
		* NOT RECOMMENDED FOR FIELD REPLACEMENT	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	Stock No.	Description	Note
A5C21	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A5C22	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A5C23	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A5C24	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A5CR1	1910-0022	SEMICON DEVICE:DIODE GERMANIUM	
A5CR2	1910-0022	SEMICON DEVICE:DIODE GERMANIUM	
A5L1	9140-0215	COIL:VAR 349.8 NH (INCLUDES C10)	
A5L2	9140-0214	COIL:VAR 287.9 NH (INCLUDES C12)	
A5L3	9140-0213	COIL:VAR 179.6 NH (INCLUDES C14)	
A5Q1 THRU A5Q4	1850-0102	TRANSISTOR:GERMANIUM PNP 2N2455	
A5Q5	1854-0019	TRANSISTOR:SILICON NPN S6516	
A5Q6	1850-0020	TRANSISTOR:GERMANIUM PNP 2N1143	
A5Q7 THRU A5Q11	1854-0019	TRANSISTOR:SILICON NPN S6516	
A5Q12	1850-0102	TRANSISTOR:GERMANIUM PNP 2N2455	
A5R1	0683-1345	R:FXD COMP 130K OHM 5% 1/4W	
A5R2	0683-1245	R:FXD COMP 120K OHM 5% 1/4W	
A5R3	2100-0902	R:VAR COMP 100K OHM 20% LIN 1/4W	
A5R4	0683-1825	R:FXD COMP 1.8K OHM 5% 1/4W	
A5R5	0683-1025	R:FXD COMP 1K OHM 5% 1/4W	
A5R6	0683-3025	R:FXD COMP 3000 OHM 5% 1/4W	
A5R7	0683-1025	R:FXD COMP 1K OHM 5% 1/4W	
A5R8	0683-1615	R:FXD COMP 160 OHM 5% 1/4W	
A5R9	0683-3025	R:FXD COMP 3000 OHM 5% 1/4W	
A5R10	0683-1825	R:FXD COMP 1.8K OHM 5% 1/4W	
A5R11	0683-1025	R:FXD COMP 1K OHM 5% 1/4W	
A5R12	0683-2015	R:FXD COMP 200 OHM 5% 1/4W	
A5R13	0683-5615	R:FXD COMP 560 OHM 5% 1/4W	
A5R14	0683-5615	R:FXD COMP 560 OHM 5% 1/4W	
A5R15	0683-1325	R:FXD COMP 1300 OHM 5% 1/4W	
A5R16	0683-5105	R:FXD COMP 51 OHM 5% 1/4W	
A5R17	0683-5115	R:FXD COMP 510 OHM 5% 1/4W	
A5R18	0683-6215	R:FXD COMP 620 OHM 5% 1/4W	
A5R19	0683-2425	R:FXD COMP 2400 OHM 5% 1/4W	
A5R20	0683-2405	R:FXD COMP 24 OHM 5% 1/4W	
A5R21	0683-2725	R:FXD COMP 2.7K OHM 5% 1/4W	
A5R22	0683-4725	R:FXD COMP 4.7K OHM 5% 1/4W	
A5R23	0683-2425	R:FXD COMP 2400 OHM 5% 1/4W	
A5R24	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A5R25	0683-9105	R:FXD COMP 91 OHM 5% 1/4W	
A5R26	0683-3925	R:FXD COMP 3.9K OHM 5% 1/4W	
A5R27	0683-5115	R:FXD COMP 510 OHM 5% 1/4W	
A5R28	0683-6815	R:FXD COMP 680 OHM 5% 1/4W	
A5R29	0683-1025	R:FXD COMP 1K OHM 5% 1/4W	
A5R30	0683-2405	R:FXD COMP 24 OHM 5% 1/4W	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	℗ Stock No.	Description	Note
A5R31	0683-1625	R:FXD COMP 1600 OHM 5% 1/4W	
A5R32	0683-2425	R:FXD COMP 2400 OHM 5% 1/4W	
A5R33	0683-1215	R:FXD COMP 120 OHM 5% 1/4W	
A5R34	0683-1525	R:FXD COMP 1.5K OHM 5% 1/4W	
A5R35	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A5R36	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
A5R37	0683-2015	R:FXD COMP 200 OHM 5% 1/4W	
A5R38	0683-7505	R:FXD COMP 75 OHM 5% 1/4W	
A5R39	0683-6205	R:FXD COMP 62 OHM 5% 1/4W	
		MISCELLANEOUS	
C1 THRU C3	05254-6008	CABLE ASSEMBLY:CAVITY OUTPUT	
	0160-0204	CAPACITOR-FXD CER 200VDCW(FEED-THRU)	
M1	1120-0140	METER:LEVEL INDICATOR	
MP1	05254-6016	CAVITY ASSEMBLY:PARTS IN THIS ASSY.,N.R.F.R.	
CONSISTS OF MP1 & MP2	1410-0204	BEARING SLEEVE	*
	3050-0381	WASHER:THRUST	*
	05254-2026	REAR CAVITY	*
	05254-2030	GEAR:DIAL DRIVE	*
	05254-2032	GEAR:DIAL TRAIN(#1)	*
	05254-2033	GEAR:DIAL TRAIN(#2)	*
	05254-2035	CAVITY:MACHINED	*
	05254-2040	SHAFT:IDLER GEAR	*
	05254-2049	BRACKET:GEAR	*
	05254-4002	BUSHING:DIAL	*
	05254-6009	FINGER MOUNT ASSEMBLY	*
MP2	05254-6002	PROBE DRIVE ASSEMBLY:CONSISTS OF:	*
	1410-0058	BEARING:BALL	*
	1460-0197	SPRING:COMPRESSION	*
	5000-0206	SPRING:WASHER	*
	5020-0233	COLLAR	*
	05254-2005	CAP:PROBE	*
	05254-2018	SUPPORT:BEARING	*
	05254-2019	SCREW:PROBE DRIVE	*
	3050-0381	WASHER:THRUST	*
	05254-2021	NUT:FLOATING BACKLASH	*
	05254-2031	GEAR:DRIVER	*
	05254-2032	GEAR:DIAL TRAIN(#1)	*
	05254-2033	GEAR:DIAL TRAIN(#2)	*
	05254-6001	ASSY:PROBE	*
MP3		NOT ASSIGNED	
MP4	05254-2051	PANEL:FRONT	
MP5	05254-0013	BRACKET:METER	
MP6	05254-0012	PLATE:TOP	
MP7	05254-0011	PLATE:SIDE	
MP8	05254-0010	PLATE:BOTTOM	
		* NOT RECOMMENDED FOR FIELD REPLACEMENT	

See introduction to this section

Table 6-1. Reference Designation Index (Cont')

Circuit Reference	Stock No.	Description	Note
MP9	5262A-83A	GUIDE:PLUG-IN(PLASTIC)	
MP10	5262A-47A	SPACER(ALUMINUM)	
MP11	1250-0227	WASHER:SILVER PLATED BRASS	
MP12	05254-0009	SIDE PLATE:AMPLIFIER	
MP13	05254-0006	BRACKET:BOARD	
MP14	05254-2028	AMPLIFIER SHIELD:MACHINED	
P6	1251-0099	CONNECTOR:MALE 50 PIN MINIATURE	
		MISCELLANEOUS	
	0370-0050	KNOB:HANDLE,PART OF KNOB	
	0370-0041	KNOB	
	1410-0204	BEARING,SLEEVE:PART OF KNOB	
	05254-6005	CABLE ASSEMBLY:VIDEO AMPLIFIER OUTPUT	
	1250-0227	WASHER:SILVER PLATED BRASS	
	05254-2014	PLUG:CAVITY OUTPUT	
	05254-4003	PIN ASSEMBLY:OUTPUT	

See introduction to this section

Table 6-2. Replaceable Parts

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	
0130-0016	C:VAR CER 5-25 PF NPO	28480	0130-0016	1	
0130-0017	C:VAR CER 8-50 UF N750	28480	0130-0017	1	
0132-0003	C:VAR TRIMMER 0.7-3.0 PF	28480	0132-0003	1	
0140-0145	C:FXD MICA 22 PF 5% 500VDCW	04062	DM15C 220J	1	
0140-0156	C:FXD MICA 1500 PF 2% 300VDCW	04062	DM19F 152G 300V	1	
0140-0178	C:FXD MICA 560 PF 2% 300VDCW	04062	DM15F 561J 300V	2	
0140-0194	C:FXD MICA 110 PF 5% 300VDCW	04062	DM15F 111J 300V	2	
0140-0195	C:FXD MICA 130 PF 5% 300VDCW	04062	DM15F 131J 300V	2	
0140-0202	C:FXD MICA 15 PF 5% 500VDCW	04062	DM15C 150J 500V	1	
0140-0209	C:FXD MICA 5 PF 10%	28480	0140-0209	1	
0140-0219	C:FXD MICA 180 PF 2%	28480	0140-0219	1	
0140-0224	C:FXD MICA 280 PF 1%	28480	0140-0224	1	
0140-0230	C:FXD MICA 420 PF 1%	28480	0140-0230	1	
0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA	19	
0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C 50A	5	
0160-0127	C:FXD CER 1.0 UF 20% 25VDCW	56289	5C 13	5	
0160-0204	CAPACITOR:FXD CER 200VDCW(FEED-THRU)	01121	SMFB-A2	3	
0160-0737	C:FXD MICA 29.3 PF	28480	0160-0737	1	
0160-0738	C:FXD MICA 44.3 PF	28480	0160-0738	1	
0160-0739	C:FXD MICA 56.2 PF	28480	0160-0739	1	
0160-0740	C:FXD MICA 39.6 PF 500VDCW	04062	DM15E(39.6 PF)D	1	
0160-0759	C:FXD MICA 1000 PF 5% 250VDCW	72982	2930-000-001A0-102J	1	
0160-0958	C:FXD MICA 390 PF 5% 300VDCW	28480	0160-0958	1	
0170-0083	C:FXD MY 0.022 UF 20% 50VDCW	28480	0170-0083	1	
360A-13	WIRE:CENTER CONDUCTOR(4")	28480	360A-13		
0370-0041	KNOB	28480	0370-0041	1	
0370-0050	KNOB:HANDLE	28480	0370-0050	1	
0410-0089	CRYSTAL:50 MC .004%	00136	OBD#	1	
0460-0055	TAPE:TEFLON 1/2"	28480	0460-0089		
0683-1015	R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015	2	
0683-1025	R:FXD COMP 1K OHM 5% 1/4W	01121	CB 1025	6	
0683-1035	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035	1	
0683-1215	R:FXD COMP 120 OHM 5% 1/4W	01121	CB 1215	1	
0683-1245	R:FXD COMP 120K OHM 5% 1/4W	01121	CB 1245	1	
0683-1325	R:FXD COMP 1300 OHM 5% 1/4W	01121	CB 1325	1	
0683-1345	R:FXD COMP 130K OHM 5% 1/4W	01121	CB 1345	1	
0683-1525	R:FXD COMP 1.5K OHM 5% 1/4W	01121	CB 1525	1	
0683-1615	R:FXD COMP 160 OHM 5% 1/4W	01121	CB 1615	1	
0683-1625	R:FXD COMP 1600 OHM 5% 1/4W	01121	CB 1625	1	
0683-1815	R:FXD COMP 180 OHM 5% 1/4W	01121	CB 1815	1	
0683-1825	R:FXD COMP 1.8K OHM 5% 1/4W	01121	CB 1825	2	
0683-2015	R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015	2	
0683-2205	R:FXD COMP 22 OHM 5% 1/4W	01121	CB 2205	1	
0683-2215	R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215	1	
0683-2405	R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405	2	
0683-2425	R:FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425	3	
0683-2725	R:FXD COMP 2.7K OHM 5% 1/4W	01121	CB 2725	2	
0683-3025	R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025	2	
0683-3325	R:FXD COMP 3.3K OHM 5% 1/4W	01121	CB 3325	1	
0683-3925	R:FXD COMP 3.9K OHM 5% 1/4W	01121	CB 3925	1	

See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	
0683-4725	R:FXD COMP 4.7K OHM 5% 1/4W	01121	CB 4725	1	
0683-5105	R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105	1	
0683-5115	R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115	5	
0683-5615	R:FXD COMP 560 OHM 5% 1/4W	01121	CB 5615	2	
0683-6205	R:FXD COMP 62 OHM 5% 1/4W	01121	CB 6205	1	
0683-6215	R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215	1	
0683-6815	R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815	1	
0683-7505	R:FXD COMP 75 OHM 5% 1/4W	01121	CB 7505	1	
0683-9105	R:FXD COMP 91 OHM 5% 1/4W	01121	CB 9105	1	
0757-0895	R:FXD MET OX 62 OHM 2% 1/8W	19701	MF 07C	2	
0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	07115	C20	1	
0758-0015	R:FXD MET FLM 220 OHM 5% 1/2W	07115	C20	1	
0758-0017	R:FXD MET FLM 1.5K OHM 5% 1/2W	07115	C20	1	
0758-0044	R:FXD MET OX 2.2K OHM 5% 1/2W	07115	C20	3	
0758-0125	R:FXD MET FLM 430 OHM 5% 1/4W	07115	C-07	2	
0758-0135	R:FXD DEPC 6.8K OHM 10% 1/10W	28480	0758-0135	1	
0890-0001	TUBING:1/2"	28480	0890-0001		
0890-0009	TUBING:1/2"	28480	0890-0009		
1120-0140	METER:LEVEL INDICATOR	60741	MODEL 120	1	
1205-0011	HEAT SINK FOR TO-5 AND TO-9 CASE	28480	1205-0011	1	
1250-0020	CONTACT:BNC FEMALE	91737	89-20	2	
1250-0227	WASHER:SILVER PLATED BRASS	91737	492A-39	2	
1251-0099	CONNECTOR:MALE 50 PIN	02660	57 10500	1	
1410-0058	SPRING:COMPRESSION	28480	1410-0058	1	
1410-0204	BEARING:SLEEVE	28480	1410-0204	2	
1460-0197	SPRING:COMPRESSION	28480	1460-0197	1	
1850-0020	TRANSISTOR:GERMANIUM PNP 2N1143	01295	2N1143	1	
1850-0102	TRANSISTOR:GERMANIUM PNP 2N2455	93332	2N2455	5	
1854-0005	TRANSISTOR:SILICON NPN 2N708	07263	2N708	5	
1854-0019	TRANSISTOR:SILICON NPN S6516	07263	S-6516	6	
1854-0035	TRANSISTOR:SILICON NPN	07263	S 6783	1	
1900-0014	DIODE:POINT CONTACT,SILICON,MATCHED SET	96341	1N831M	2	
1901-0153	SEMICON DEVICE:DIODE SILICON	28480	BE-0004	1	
1910-0022	SEMICON DEVICE:DIODE GERMANIUM	73293	HD-1872	2	
2100-0902	R:VAR COMP 100K OHM 20% LIN 1/4W	01121	FR-104-M	1	
3030-0149	SET SCREW:#0-80 X 3/32"	28480	3030-0149	2	
3050-0381	WASHER:THRUST	28480	3050-0381	2	
5000-0206	SPRING:WASHER	28480	5000-0206	1	
5020-0233	COLLAR	28480	5020-0233	2	
05254-0006	BRACKET:BOARD	28480	05254-0006	1	
05254-0008	SUPRESSOR:MODE	28480	05254-0008	1	
05254-0009	SIDE PLATE:AMPLIFIER	28480	05254-0009	1	
05254-0010	PLATE:BOTTOM	28480	05254-0010	1	
05254-0011	PLATE:SIDE	28480	05254-0011	1	
05254-0012	PLATE:TOP	28480	05254-0012	1	
05254-0013	BRACKET:METER	28480	05254-0013	1	
05254-2004	INSERT:REAR AMPLIFIER	28480	05254-2004	1	
05254-2005	CAP:PROBE	28480	05254-2005	1	
05254-2008	CAPACITOR MOUNT:MIXER	28480	05254-2008	1	
05254-2009	CONTACT:MIXER	28480	05254-2009	1	
05254-2010	INSERT:FRONT AMPLIFIER	28480	05254-2010	1	

See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	
05254-2011	INSERT:MIXER OUTPUT	28480	05254-2011	1	
05254-2012	CONNECTOR:REAR,MIXER	28480	05254-2012	1	
05254-2014	PLUG:CAVITY OUTPUT	28480	05254-2014	1	
05254-2018	SUPPORT:BEARING	28480	05254-2018	1	
05254-2019	SCREW:PROBE DRIVE	28480	05254-2019	1	
05254-2021	NUT:FLOATING BACKLASH	28480	05254-2021	1	
05254-2026	REAR:CAVITY	28480	05254-2026	1	
05254-2027	CONNECTOR:INPUT	28480	05254-2027	1	
05254-2028	AMPLIFIER SHIELD:MACHINED	28480	05254-2028	1	
05254-2030	GEAR:DIAL DRIVE	28480	05254-2030	1	
05254-2031	GEAR:DRIVER	28480	05254-2031	1	
05254-2032	GEAR:DIAL TRAIN(#1)	28480	05254-2032	2	
05254-2033	GEAR:DIAL TRAIN(#2)	28480	05254-2033	2	
05254-2035	CAVITY:MACHINED	28480	05254-2035	1	
05254-2037	PART OF CONDUCTOR,CAPACITOR	28480	05254-2037	2	
05254-2038	RING:MIXER GROUND	28480	05254-2038	1	
05254-2039	DIODE MOUNT	28480	05254-2039	1	
05254-2040	SHAFT:IDLER GEAR	28480	05254-2040	1	
05254-2041	STUD:THREADED	28480	05254-2041	1	
05254-2043	BLANK PRINTED CIRCUIT BOARD	28480	05254-2043	1	
05254-2044	BLANK PRINTED CIRCUIT BOARD	28480	05254-2044	1	
05254-2045	FILTER SECTION I	28480	05254-2045	2	
05254-2046	FILTER SECTION II	28480	05254-2046	1	
05254-2047	FILTER SECTION III	28480	05254-2047	2	
05254-2048	SLEEVE:RF FILTER	28480	05254-2048	1	
05254-2049	BRACKET:GEAR	28480	05254-2049	1	
05254-2050	SPACER:FILTER TERMINATION	28480	05254-2050	1	
05254-2051	PANEL:FRONT	28480	05254-2051	1	
05254-4001	CAPACITOR ASSEMBLY:INPUT	28480	05254-4001	1	
05254-4002	BUSHING:DIAL	28480	05254-4002	1	
05254-4003	PIN ASSEMBLY:OUTPUT	28480	05254-4003	1	
05254-6001	PROBE ASSEMBLY	28480	05254-6001	1	
05254-6002	PROBE DRIVE ASSEMBLY	28480	05254-6002	2	
05254-6004	VIDEO AMPLIFIER ASSEMBLY	28480	05254-6004	1	
05254-6005	CABLE ASSEMBLY:VIDEO AMPLIFIER OUTPUT	28480	05254-6005	2	
05254-6006	MIXER ASSEMBLY	28480	05254-6006	1	
05254-6008	CABLE ASSEMBLY:CAVITY OUTPUT	28480	05254-6008	1	
05254-6009	FINGER MOUNT ASSEMBLY	28480	05254-6009	1	
05254-6010	MULTIPLIER AMPLIFIER ASSEMBLY	28480	05254-6010	1	
05254-6011	TOROID ASSEMBLY:WOUND	28480	05254-6011	1	
05254-6012	HARMONIC GENERATOR ASSEMBLY	28480	05254-6012	1	
05254-6013	RF FILTER ASSEMBLY	28480	05254-6013	1	
05254-6016	CAVITY ASSEMBLY	28480	05254-6016	1	
5262A-47A	SPACER:ALUMINUM	28480	5262A-47A	3	
5262A-83A	GUIDE:PLUG-IN(PLASTIC)	28480	5262A-83A	1	
8151-0012	WIRE:#20 AWG(1 1/2")	28480	8151-0012	1	
9140-0018	COIL:RF 1UH	99848	205-11-10	2	
9140-0031	COIL:RF 75 UH	99848	1075-15-750	2	
9140-0107	COIL:FXD RF 27 UH	28480	9140-0107	7	
9140-0213	COIL:VAR 179.6 NH	36196	H-10693-A	1	
9140-0214	COIL:VAR 287.9 NH	36196	H-10692-A	1	
9140-0215	COIL:VAR 349.8 NH	36196	H-10691-A	1	

See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	
9140-0218	COIL:VAR TUNABLE 80 NH	04811	PC-80-L57-06	2	
9140-0219	COIL:VAR TUNABLE 115 NH	04811	PC-115-L57-06	2	
9140-0220	COIL:VAR TUNABLE 175 NH	04811	PC-L57-06	1	
9140-0221	COIL:VAR TUNABLE 800 NH	04811	PC-800-L57-06	1	

See introduction to this section

Table 6-3. Manufacturer's Code List

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00334	Humidaml Co.	Colton, Calif.
00335	Westrex Corp.	New York, N.Y.
00373	Garlock Packing Co., Electronic Products Div.	Camden, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Company, Ordill Division (Capacitors)	Marion, Ill.
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	Pacific Semiconductors, Inc.	Culver City, Calif.
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01561	Chassi-Trak Corp.	Indianapolis, Ind.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02286	Cole Mfg. Co.	Palo Alto, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	El Monte, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.	Morristown, N.J.
03954	Air Marine Motors, Inc.	Los Angeles, Calif.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04062	Elmenco Products Co.	New York, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04298	Elgin National Watch Co., Electronics Division	Burbank, Calif.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Prods., Inc. Electronic Tube Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc., Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04777	Automatic Electric Sales Corp.	Northlake, Ill.
04796	Sequoia Wire & Cable Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P. M. Motor Company	Chicago 44, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp., Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illumitronic Engineering Co.	Sunnyvale, Calif.
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metropolitan Telecommunications Corp., Metro Cap. Division	Brooklyn, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
06004	The Bassick Co.	Bridgeport, Conn.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06751	U. S. Semcor Division of Nuclear Corp. of America	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
07115	Corning Glass Works Electronic Components Dept.	Bradford, Pa.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07700	Technical Wire Products	Springfield, N.J.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.
07966	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.
07980	Boonton Radio Corp.	Boonton, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada.
08717	Sloan Company	Burbank, Calif.
08718	Cannon Electric Co., Phoenix Div.	Phoenix, Ariz.
08792	CBS Electronics Semiconductor Operations, Div. of C.B.S., Inc.	Lowell, Mass.
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays, Inc.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09664	The Bristol Co.	Waterbury, Conn.
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11312	Microwave Electronics Corp.	Palo Alto, Calif.
11534	Duncan Electronic, Inc.	Santa Ana, Calif.
11711	General Instrument Corporation Semiconductor Division	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12697	Clarostat Mfg. Co.	Dover, N.H.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
13103	Thermalloy	Dallas, Texas
13396	Telefunken (G.M.B.H.)	Hannover, Germany
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14655	Cornell Dubilier Elec. Corp.	So. Plainfield, N.J.
15909	The Daven Co.	Livingston, N.J.
16688	De Jur-Amsco Corporation	Long Island City 1, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19701	Electra Manufacturing Co.	Kansas City, Mo.
20183	Electronic Tube Corp.	Philadelphia, Pa.
21226	Executive, Inc.	New York, N.Y.
21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.
21335	The Fafnir Bearing Co.	New Britain, Conn.
21964	Fed. Telephone and Radio Corp.	Clifton, N.J.
24446	General Electric Co.	Schenectady, N.Y.
24455	G.E., Lamp Division Nela Park,	Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Corp.	Hawkesbury, Ontario, Canada
37942	P.R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.
49956	Raytheon Company	Lexington, Mass.
52090	Rowan Controller Co.	Baltimore, Md.
63743	Ward Leonard Electric	Mt. Vernon, N.Y.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Sorenson & Co., Inc.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex, Inc.	St. Paul, Minn.
59730	Thomas & Betts Co.	Elizabeth 1, N.J.
60741	Tripplett Electrical Inc.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Swissvale, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.
66295	Wittek Manufacturing Co.	Chicago 23, Ill.
66346	Wollensak Optical Co.	Rochester, N.Y.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control Co., Inc.	New York, N.Y.
70319	Allmetal Screw Prod. Co., Inc.	Garden City, N.Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	New York, N.Y.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio Inc.	Cleveland, Ohio
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Allen D. Cardwell Electronic Prod. Corp.	Plainville, Conn.
71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71450	CTS Corp.	Elkhart, Ind.
71468	Cannon Electric Co.	Los Angeles, Calif.
71471	Cinema Engineering Co.	Burbank, Calif.
71482	C. P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71700	The Cornish Wire Co.	New York, N.Y.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71753	A.O. Smith Corp., Crowley Div.	West Orange, N.J.
71785	Cinch Mfg. Corp.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72092	Eitel-McCullough, Inc.	San Bruno, Calif.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
71707	Coto Coil Co., Inc.	Providence, R.I.
72354	John E. Fast & Co.	Chicagd, Ill.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	General Ceramics Corp.	Keasbey, N.J.
72699	General Instrument Corp., Semiconductor Div.	Newark, N.J.
72758	Girard-Hopkins	Oakland, Calif.
72765	Drake Mfg. Co.	Chicago, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Resistor Corp.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. of North American Phillips Co, Inc.	Hicksville, N.Y.
73490	Beckman Helipot Corp.	So. Pasadena, Calif.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Inc.	Philadelphia, Pa.
73734	Federal Screw Prod. Co.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75173	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.
75378	James Knights Co.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	Micamold Electronic Mfg. Corp.	Brooklyn, N.Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	Bendix Pacific Division of Bendix Corp.	No. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phaostran Instrument and Electronic Co.	South Pasadena, Calif.
77250	Phoell Mfg. Co.	Chicago, Ill.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	Potter and Brumfield, Div. of American Machine and Foundry	Princeton, Ind.
77630	Radio Condenser Co.	Camden, N.J.
77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	Pasadena, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products	Elizabeth, N.J.
80130	Times Facsimile Corp.	New York, N.Y.
80131	Electronic Industries Association. Any brand tube meeting EIA standards	Washington, D.C.
80207	Unimax Switch, Div. of W.L. Maxson Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Fulton Controls Co.	Columbus 16, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80583	Hammerlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments, Inc.	New Haven, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Electronics Co., Inc.	Norwalk, Conn.
81349	Military Specification	.....
81415	Wilkor Products, Inc.	Cleveland, Ohio
81453	Raytheon Mfg. Co., Industrial Components Div., Industr. Tube Operations	Newton, Mass.
81483	International Rectifier Corp.	El Segundo, Calif.
81541	The Airpax Products Co.	Cambridge, Mass.
81860	Barry Controls, Inc.	Watertown, Mass.
82042	Carter Parts Co.	Skokie, Ill.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Allen B. DuMont Labs, Inc.	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Div.	Emporium, Pa.
82376	Astron Co.	East Newark, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc., Spencer Prods.	Attleboro, Mass.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.

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H4-1 Dated Oct. 1963
H4-2 Dated March 1962

Table 6-3. Manufacturer's Code List (cont'd)

Code No.	Manufacturer	Address
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	Pyramid Electric Co.	Darlington, S.C.
83148	Electro Cords Co.	Los Angeles, Calif.
83186	Victory Engineering Corp.	Union, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83740	Eveready Battery	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
84171	Arco Electronis, Inc.	New York, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	Good All Electric Mfg. Co.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	New Haven, Conn.
85674	Midland Mfg. Co. Inc.	Kansas City, Mo.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	Seattle, Wash.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Inc. Co.	Oakland, Calif.
89473	General Electric Distributing Corp.	Schenectady, N.Y.
89636	Carter Parts Div. of Economy Baler Co.	Chicago, Ill.
89665	United Transformer Co.	Chicago, Ill.
90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Brothers', Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Philadelphia, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91929	Minneapolis-Honeywell Regulator Co., Microswitch Div.	Freeport, Ill.
92180	Tru-Connector Corp.	Peabody, Mass.
92196	Universal Metal Prod., Inc.	Bassett Puente, Calif.
92367	Elgeet Optical Co., Inc.	Rochester, N.Y.
92607	Tinsolite Insulated Wire Co.	Tarrytown, N.Y.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins and Myers, Inc.	New York, N.Y.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93788	Howard J. Smith Inc.	Port Monmouth, N. J.
93929	G. V. Controls	Livingston, N. J.
93983	Insuline-Van Norman Ind., Inc. Electronic Division	Manchester, N.H.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Mfg. Co., Industrial Components Div., Receiving Tube Operation	Quincy, Mass.
94145	Raytheon Mfg. Co., Semiconductor Div., California Street Plant	Newton, Mass.
94148	Scientific Radio Products, Inc.	Loveland, Colo.
94154	Tung-Sol Electric, Inc.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.
94222	Southco Div. of S. Chester Corp.	Lester, Pa.
94310	Tru Ohm Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
95023	Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	New York, N.Y.
95264	Lerco Electronics, Inc.	Burbank, Calif.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordas Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Chicago, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Division of Aerovox	Olean, N.Y.
96256	Thordarson-Meissner Div. of Maguire Industries, Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic and Precision Mfg. Co.	Yonkers, N.Y.
97966	CBS Electronics, Div. of C.B.S., Inc.	Danvers, Mass.
97979	Reon Resistor Corp.	Yonkers, N.Y.
98141	Axel Brothers Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Francis L. Mosley	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98405	Carad Corp.	Redwood City, Calif.
98731	General Mills	Minneapolis, Minn.
98821	North Hills Electric Co.	Mineola, N.Y.
98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99515	Marshall Industries, Electron Products Division	Pasadena, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.
99957	Technology Instrument Corp of Calif.	Newbury Park, Calif.

Code No.	Manufacturer	Address
	THE FOLLOWING H-P VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.	
C0000	JFD Electronics Corp.	Van Nuys, Calif.
G0000	Tranex Company	Mountain View, Calif.
I0000	Western Devices, Inc.	Inglewood, Calif.
J0000	Winchester Electronics, Inc.	Santa Monica, Calif.
0000F	Malco Tool and Die	Los Angeles, Calif.
0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
0000N	Nahm-Bros. Spring Co.	San Leandro, Calif.
0000P	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
0000T	Texas Instruments, Inc. Metals and Controls Div.	Versailles, Ky.
0000U	Tower Mfg. Corp.	Providence, R.I.
0000W	Webster Electronics Co. Inc.	New York, N.Y.
0000X	Spruce Pine Mica Co.	Spruce Pine, N.C.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AA	British Radio Electronics Ltd.	Washington, D.C.
000AB	ETA	England
000AC	Indiana General Corp., Elect. Div.	Indiana
000AD	Curtis Instrumept Inc.	Mt. Kisco, N.Y.
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CC	Computer Diode Corp.	Lodi, N.J.
000EE	A. Williams Manufacturing Co.	San Jose, Calif.
000GG	Goshen Die Cutting Service	Goshen, Ind.
000HH	Rubbercraft Corp.	Torrance, Calif.
000II	Birtcher Corporation, Industrial Division	Monterey Park, Calif.
000KK	Amatom	New Rochelle, N.Y.
000LL	Avery Label	Monrovia, Calif.
000MM	Rubber Eng. & Development	Hayward, Calif.
000Nñ	A "N" D Manufacturing Co.	San Jose 27, Calif.
000PP	Atohm Electronics	Sun Valley, Calif.
000QQ	Cooltron	Oakland, Calif.
000RR	Radio Industries	Des Plaines, Ill.
000SS	Control of Elgin Watch Co.	Burbank, Calif.
000WW	California Eastern Lab.	Burlingame, Calif.
000XX	Methode Electronics, Inc.	Chicago 31, Ill.
000YY	S.K. Smith Co.	Los Angeles 45, Calif.

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APPENDIX I - MANUAL CHANGES

This manual applies directly to the 5254A Frequency Converters having serial prefix number 514. This manual with the following changes also applies to 5254A Frequency Converters having serial prefix numbers 429 and 415.

To adapt this manual to instruments with serial prefix numbers other than 514, make changes as follows.

Instrument Serial Prefix	Change No.
429, 415	1

CHANGE 1:

Figure 5-9, Tables 6-1, 6-2, Change: A5R2 to 100K ohms, hp Part No. 0683-1045.

Tables 6-1, 6-2, Change: MP4 to hp Part No. 05254-2029
MP5 to hp Part No. 05254-0007
MP6 to hp Part No. 05254-0004
MP7 to hp Part No. 05254-0003
MP8 to hp Part No. 05254-0002
MP12 to hp Part No. 05254-0001

HP SALES AND SERVICE OFFICES IN THE U.S. AND CANADA

ALABAMA

Huntsville, 35801
Hewlett-Packard
Southern Sales Division
Holiday Office Ctr., Suite 18
(205) 881-4591
TWX: 510-579-2204

ARIZONA

Scottsdale, 85251
Hewlett-Packard
Neely Sales Division
3009 No. Scottsdale Rd.
(602) 945-7601
TWX: 602-949-0111

Tucson, 85716
Hewlett-Packard
Neely Sales Division
232 So. Tucson Blvd.
(602) 623-2564
TWX: 602-792-2759

CALIFORNIA

Los Angeles Area
Hewlett-Packard
Neely Sales Division
3939 Lankershim Blvd.
North Hollywood 91604
(213) 877-1282 and 766-3811
TWX: 910-499-2170

Sacramento, 95821
Hewlett-Packard
Neely Sales Division
2591 Carlsbad Ave.
(916) 482-1463
TWX: 916-444-8683

San Diego, 92106
Hewlett-Packard
Neely Sales Division
1055 Shafter Street
(714) 223-8103
TWX-714-276-4263

San Francisco Area
Hewlett-Packard
Neely Sales Division
1101 Embarcadero Rd.
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